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SALADOID ECONOMY AND COMPLEXITY ON THE ARAWAKAN FRONTIER

By

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This dissertation is dedicated to the memory of Janine Devereaux, whose chutzpa and “go for it” attitude toward life has always been an inspiration.

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ABSTRACT

The study of tribal societies has long been riddled with questions regarding the validity of categorization of levels complexity, and how societal organizational structures change from perceived autonomy to interdependency and centralization. Long regarded as existing in a transitory and evolutionary stage between simple, egalitarian bands and more institutionally complex, hierarchical chiefdoms and states, tribes have traditionally been defined as "bounded groups of culturally similar people," as autonomous, semi-sedentary or sedentary communities with limited surplus production of subsistence goods. Older presumptions equating complexity with institutionalized social hierarchies were simplistic, and are giving way to new, more dynamic understandings. Egalitarianism is no longer an assumed tribal fact. Social inequality is present in nearly all political forms, and is based not only on the classic definition of control of wealth and status by a few. Inequality of social status and rank is found in the management and control of transportation of prestige and sacred goods, skills in creating prestige and sacred objects that demonstrates control of the supernatural, control of ritual spiritual knowledge, and knowledge of the foreign and distant. By examining political economy, systems of production, exchange, and the locations of places of settlement, interaction, and communication across the landscape we can begin to understand the interconnected relations between all these system components, and begin to view the collective, complex whole.

Regarding the Caribbean region, the early ceramic-making farmer-fishers commonly referred to as Saladoid have been most often described as egalitarian tribes. Until recently, much of the effort by archaeologists focused on the Caribbean region has been concentrated on the development of hierarchical "chiefdom" societies of the Ostionoid period. The majority of these investigations have followed Rouse's culture-historical models established in the 1930s and continually developed until his death in 2005, based in assumptions of migration and diffusion models. Social change, as evidenced in material culture, was explained as adaptations to external forces, namely environmental settings and arrivals of new cultural groups. Innovation was not considered as potential explanations for socio-political change until the last several decades.

This dissertation is a study of complexity and processes of socio-organizational change, using as a case study systems of socio-political organization and economy of Saladoid era peoples on St. Croix, U.S. Virgin Islands. A contextual approach is utilized that builds on both complexity (systems) and practice theories. The potential variability of forms of socio-political organization among so-called tribal communities is discussed, and questions and definitions of complexity are addressed through the examination of old assumptions of Saladoid-Caribbean

peoples as simply "egalitarian societies." It is argued that, archaeologically, the Saladoid peoples demonstrate heterarchy in a variety of socio-organizational forms generated through processes of ethnogenesis; communities may appear to be ranked in a number of different and altering ways, depending on context and changing values, and changes are generated through both internal and external interactions and innovations. As defined by Brumfiel (1995:128), heterarchy is not representative of "a single type of social structure; rather, it is a principle of social organization." Heterarchy does not assume that economic and political complexity and hierarchy are necessarily bound together.

In particular, the research demonstrates patterns of contact and exchange between island societies by examining the social dynamics and political structures of the peoples of St. Croix within the larger Greater Antilles and northern Leeward Island interaction sphere from the Saladoid (ca. 400 B.C. – A.D. 600) through the Early Ostionoid (ca. A.D. 600 – 900) periods. These patterns are illustrated through the analysis of settlement patterns and artifacts associated with craft production, namely finely made ceramics, ceremonial and polished stone celts, and carved stone ornaments and beads made of non-local materials.

A model for Saladoid exchange economy is proposed, using theories of practice and complexity and Complex Adaptive Systems (CAS) models. It is argued that complexity theory, with a CAS and small worlds approach, can provide a framework for understanding how local interaction and experience, over time, can affect an entire system, and serves as the basis for examining questions of processes of change in socio-political organization. CAS models integrate the traits, properties and interactions of individuals (agents) into explanations of how these interactions result in the emergence or development of system-wide patterns of organization, adaptation, and innovation. These patterns continually emerge and develop, and new components are constantly introduced to the system as others fall off. Complexity incorporates the notion that changes in all evolving systems are based on a multiplicity of causes rather than a single cause or prime mover.

CHAPTER 1

INTRODUCTION

The study of tribal societies has long been riddled with questions regarding the validity of categorization of levels complexity, and how societal organizational structures change from perceived economic autonomy to interdependency and centralization. Long presumed to exist in a transitory and evolutionary stage or level between simple, egalitarian bands and more institutionally complex, hierarchical chiefdoms and states, tribes have traditionally been defined as "bounded groups of culturally similar people," as autonomous, semi-sedentary or sedentary communities with limited surplus production of subsistence goods (Creamer and Haas 1985). Many models have been developed in attempts to explain the evolution of social complexity on the basis of surplus development and management, environmental circumscription and population pressure, warfare, and the creation and management of surplus (Braun and Plog 1982; Carneiro 1970, 1974; Cowgill 1975; Peebles and Kus 1977; Sahlins 1958, 1968, 1972; Service 1971; Steponaitis 1978). At the core of many of these models (and ensuing debates) is the dynamic relationship between environmental or external and sociological or internal agents of change, and whether one imparts greater influence on how societies organize, conceptualize, and understand their worlds than the other.

Archaeologists observe the material remains of these societies and organize them into a number of discrete categories, distinguishing forms of political, economic, and other units of organization based in modern ethnographic observation. Many terms have been created and adopted that further narrow these categories, viewed by many as existing along continuum between the two extremes of egalitarianism and complexity. The creation of new terminology — middle range, intermediate, autonomous, transegalitarian, complex communal societies, chieftaincies, etc. — obfuscates a core problem: that assumptions of what is traditionally defined as "egalitarian" and "complex" need to be reevaluated. In fact, the egalitarian/complex dichotomy is a false or, at the very least, simplistic understanding of how societies are structurally organized and interact both amongst themselves and others (Chapman 2003:197). In other words, our categorical notions of "tribe" and "chiefdom" do not account for the variability in social organization that has been observed, evidenced by research on patterns of subsistence, settlement, and diachronic processes of cultural evolution and socio-political organizational change.

Egalitarianism is no longer an assumed tribal fact. It is now accepted by many researchers that social inequality is present in nearly all socio-political forms. Archaeological definitions of egalitarianism and complexity are no longer solely based on conceptions of status according to economic opportunities to access goods via any number of means of controlling labor. Instead, it is now recognized that inequality and rank or status is achievable through accessibility to knowledge of the sacred, the supernatural, the unknown or "Other," and by owning skills necessary for craft production, especially for those goods and objects regarded with prestige, sacred, and/or symbolic value. By examining socio-political economy, systems of production, interaction, exchange, and the locations of their settlements across the landscape we can begin to understand the interconnected relations between all these components.

Recent conceptions of complexity incorporate the notion that changes in all evolving systems are based on a multiplicity of influences and factors rather than a single cause or prime mover. Observable markers of social complexity have included evidence for extensive trade, sedentism, increased mortuary ceremonialism and differential distribution of grave goods, craft specialization, growing populations placing stress on resources, resulting in intensification of subsistence patterns. However, complexity is more than the presence of institutionalized social inequality or hereditary status, but is evident via social interaction and integration within a regional network (Johnson and Lundberg, 1982, manuscript on file, VI Territorial Office). All agents, whether as individuals, groups, villages, or even larger regional networks, are interconnected so that changes in one arena affect others. Complexity, in this context, is viewed as "the capacity of nonlinear interactions within clusters of activities and processes (both social and natural) to generate emergent structuring through self-organization" (McGlade 2003:115). In this way, complexity can exist without hierarchy and without centralization.

Historical trajectories of greater and lesser societal integration and organization have been termed by several researchers as processes of "tribal cycling," in which societies increase and decrease in their organizational and economic "complexity" as determined by their own historical trajectories of descendency, interaction and exchange relationships, environment, and the experiences and practices of both individuals and the society as a whole (Chapman 2003; Parkinson 2002). This process is similar to models of chiefly cycling model for Mississippian period societies in the southeastern United States, where individual chiefdoms developed, ascended in regional importance, and then gradually collapsed as others rose to prominence (Anderson 1996). Models of coalescence, dispersion, and amalgamation into new forms are similar to those for creolization processes, defined as "a process involving multicultural interaction and exchange that produces new cultural forms" (Singleton 1999:5). In short, creolization has been identified as a 3-step process — reduction, configuration, and exchange — in which symbols are simplified and reorganized when exposed to new, foreign traits (Buiseseret 2000). Creolization theory encompasses the dynamic and diachronic nature of social interaction by utilizing an amalgamation of symbols and materials from a variety of sources without necessarily assuming cultural superiority of one group over another. The creole itself develops as the result of contact and a need to communicate, while at the same time serving (whether intentionally or unintentionally) as a marker of social identity and group belonging.

Regarding the Caribbean region, the early ceramic-making farmer-fishers commonly referred to as Saladoid have been most often described as egalitarian tribes. These Early Ceramic Saladoid peoples, originally living along the middle Orinoco River of lowland Amazonia, made fine, high-fired decorated pottery and planted gardens where they grew manioc and many kinds of fruits. Possibly because of competition for limited arable land and increasing populations, around ca. 1000 – 500 B.C., groups of Early Ceramic Saladoid peoples traveled down the Orinoco, crossed the Gulf of Paria, then spread both east and west along the Venezuelan and Guayanan coasts, continuing up to the islands of the northern Lesser Antilles and the Vieques Sound (Figure 1; Hornborg 2005; Heckenberger 2002; Oliver 1989; Rouse 1986). This event is often presented as a single migration of a homogenous cultural group, though today this perception is changing. They then reached the larger, environmentally diverse sedimentary islands of the Virgin Islands, Puerto Rico, and eastern Hispaniola. It was here that the Arawakan Saladoid peoples halted their travels. By ca. A.D. 400 – 600, larger villages were budding off and smaller villages were established in more isolated areas. Political and economic fragmentation, though, soon resulted in coalescence and reorganization into the institutionalized hierarchical chiefdoms of the later Ostionoid period, commonly referred to as the Taíno.

Until recently, much of the effort by archaeologists interested in the Caribbean region has been focused on the development of hierarchical "chiefdom" societies of the Ostionoid period. The majority of these investigations have following Rouse's culture-historical models established in the 1930s and continually developed until his death in 2005, based in assumptions of migration and diffusion. Social change, as evidenced in material culture, was explained as adaptations to external forces, namely environmental settings and arrivals of new cultural groups. Innovation was not considered as potential explanations for socio-political change until the last several decades (Curet 1992a, 2003; Moscoso 1981; Siegel 1989, 1996, 1999). Few studies have been conducted of the culture and economy of the Saladoid era in any formal sense, the exception being brief discussions concerning the presence of nonlocal semi-precious raw stone materials and finished products, like beads, ornaments, and celts. However, a few studies have been conducted at individual sites on a few islands, such as in the Bahamas (Keegan and Maclachlan 1989; Keegan 1995), the Caymans, Anguilla (Crock 2000), and Grenada (Cody 1990, 1991), and a recent regional study focused on the movement of chert across the northern Lesser Antilles (Knippenberg 2006).

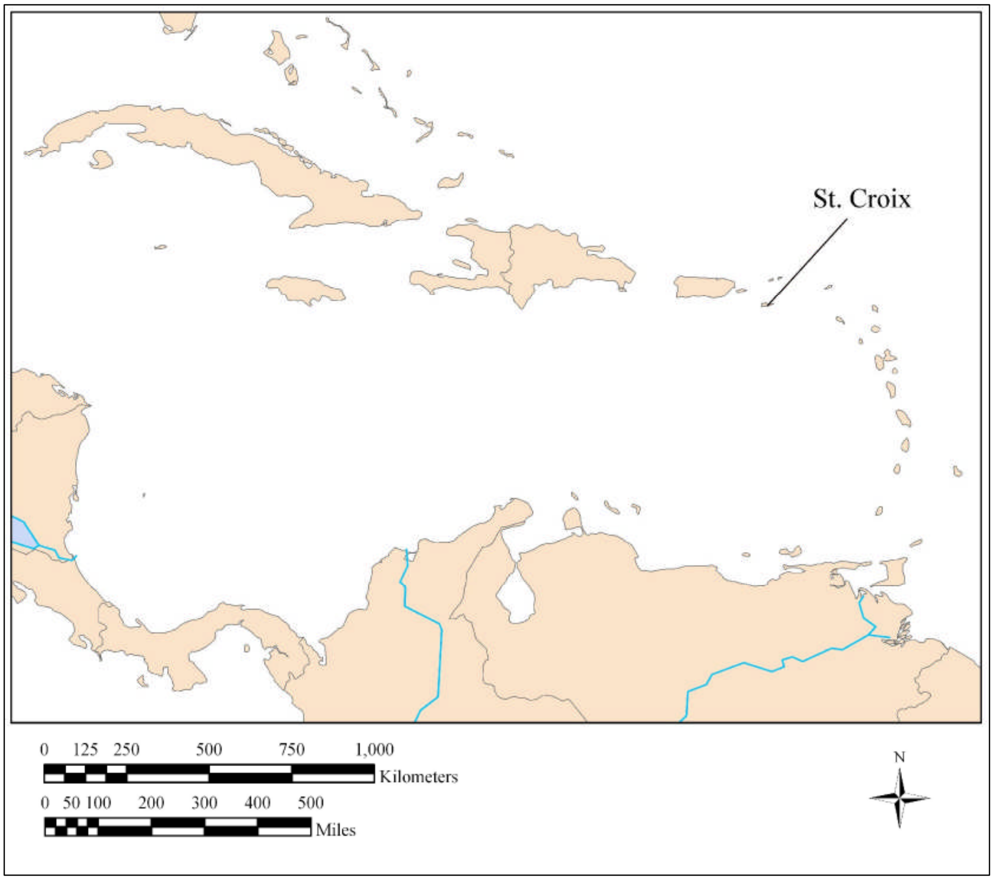


Figure 1. General map of Caribbean and St. Croix.

There are many unanswered questions relating to the integration of Saladoid period societies across the Caribbean region and their forms of socio-political organization. Assumptions of Saladoid economic and socio-political systems being something similar to "Big Man Collectivities," with possible *Kula*-like spheres of circulation have largely gone untested. Stereotypes of egalitarianism persist, despite the growing ethnological and archaeological data for complex interaction and exchange networks. Likewise, models of socio-economic systems and spheres of interaction, communication, and exchange for the Caribbean have only recently been presented (Boomert 2000a; Knippenberg 2006). A primary reason why exchange systems have not been closely examined has been a lack of geochemical identification and adequate geological surveys identifying potential sources of these materials, in order to accurately follow the movement of goods across and within the Caribbean region.

A Developing Island Archaeology

Initially, island archaeology was largely inspired by models of island biogeography from ecological studies, with an emphasis on the relation of stress on limited resources in circumscribed environments between populations (groups of individuals), communities (assemblages of different populations that demonstrate cohesion and interdependence), and ecosystems (Dickerson and Robinson 1985; Hedges 2001; MacArthur and Wilson 1963, 2001 (1967)). Biogeography is, in essence, the study of the geographical distribution of biological organisms and the variation of all biological features across a given region. Islands were viewed as "ideal laboratories" for studying the effects of environmental factors that control biodiversity. According to MacArthur and Wilson (1963, 2001), rapid colonization of an island results in the colonizing populations (propagule) occupying niches similar to those of their origins. As newer populations arrive competition for circumscribed resources would result in either the extinction of one species, or both species changing due to isolation (both temporal and spatial). It was assumed that an eventual state of dynamic equilibrium between immigration and extinction rates would be reached, and that over time the number of equilibrium species would increase (Dickerson and Robinson 1985:966). Today, however, it is recognized that immigration and extinction is recurrent and ongoing, and that island ecology is complex and dynamic (Lomolino 2000). There are also many factors that are recognized as affecting species variation, such as geographic isolation, speciation (in situ development of new species), hybridization, backcrossing of established species and hybrids (introgression or hybridization) with new arrivals, and genetic mutation. In these ways, an archaeological separation island versus mainland societies is largely artificial, in that "islands" are recognized ecologically for mainland areas, but can provide insight into behaviors and degrees of interaction and integration during processes of migration, diffusion, innovation, ethnogenesis, and creolization, among others.

Island archaeology was originally defined by these biogeographical concerns of dispersal, adaptation, radiation, competition, and extinction, and tended to minimize the effect of cultural "noise" (Broodbank 2000:29). As with the original theoretical model, today it is recognized that island societies (in fact all societies) are complex, with their own historical trajectories, paths, lessons learned and passed on, experiences and relations. Change is not necessarily the result of outside or external factors imposed on a group, but is also internally generated.

A "biogeography framework," however, can be used as a kind of baseline for studying change in island societies by investigating the "geometric properties" of size, distance, and spatial configuration and patterning (Broodbank 2000). Spatial models can be developed based on the physical realities of the land and the sea which can be used to postulate how people traveled and established communities, though they must be compatible with the socio-cultural influences and the histories of societies and their surroundings. Some aspects of developing and changing island culture may be interpreted as adaptive strategies, but other elements may demonstrate no sign of being evolutionarily adaptive (Paynter 1989). Definitions of isolation and insularity themselves are not bounded by the terrestrial confines of the shoreline, and the cultural landscapes of island societies incorporate both sea and land as part of their familiar world, components of group and community identity and definitions of in-group membership. Insularity itself is a form of social identity and cultural strategy that is defined and manipulated by both islanders themselves and mainlanders with whom they maintain relations. Oceans and seas can be viewed as either barriers or facilitators of transportation and exchange, meaning that the geographical or physical boundary of a terrestrial land bounded by water does not make an island a closed or bounded system.

Island societies, in many cases, maintain contacts with the mainland for a variety of reasons. Societal distinctions are therefore created and maintained as islanders defined themselves as such, with their seafaring culture as the bases for organization, the focus of myth and folklore, and a primary and reliable source of food. Insularity (or isolation) is defined by a people as a response to their surroundings; it is a cultural construct and a form of social identity. A distinction must be made between coastal and maritime societies and adaptation. Coastal societies are those with subsistence lifestyles based on the margins of bodies of water, which include regular aquatic habitat foods. On the other hand, maritime societies are those in which people regularly use boats for travel, to voyage, and to obtain food; in many cases, aquatic foods comprise the majority of a maritime society's subsistence (Erlandson and Fitzpatrick 2006:9). Maritime culture as defined by island societies is key to understanding the organization of these societies because the primary means of transportation, communication, and interaction are via waterways. Maritime culture here includes a society's definitions of how and who uses the seas, why they travel, where they go, and for what reasons (Broodbank 2000:34).

Cultural processes of change and adaptation that occur on islands are often compared to the "founder effect" (Mayr 1954). The founder effect alludes to the loss of certain elements of the "parent culture" from the homeland by island societies as they change over time, as well as the retention of other elements. According to Broodbank (2000:20), "loss of cultural traits, deviation, and the curation of archaisms were strategies through which island identities were created and sustained by people who remained aware of how things were done elsewhere." In this way, insular social identity can be viewed as a form of resistance, a series of choices made by people seeking to define themselves as distinct from mainland or other island contacts, possibly as a response to changes on the mainland. Islanders themselves determine the levels, terms, and rates of cross-cultural interaction.

It must also be stated that island colonization is a purposeful, intentional act, requiring in many cases large vessels capable of long-distance voyaging. In most cases, these colonizers were/are agriculturalists who brought with them the "'transported landscapes' of domesticated plants and animals necessary for survival," in addition to their belief systems and their methods of maintaining social contacts and obtaining desirable goods (Erlandson and Fitzpatrick 2006:15). Once they arrived they began to interact with their surroundings and with each other, forming new lines of communication and interaction that, over time, would develop into unique yet related social forms. When people sail to new areas and establish colonies or new settlements, they typically do not travel blindly; they journey to a region that are already familiar to them, though to what degree of familiarity is unknown.

Examples of Island Exchange Systems

Research into socio-political organization and change, and the production and movement of status goods in island settings has been conducted in the Lapita culture area of Melanesia and Polynesia (Earle 1987a, 1987b, 2002 [1977]; Gumerman 1986; Irwin 1978; Kirch 1986a, 1986b, 1988, 1991; Weisler 1998), the Cyclades (Broodbank 1989, 1993, 2000), and the Channel Islands (Arnold 1992, 1995, 2001), among many other regions around the world. Geochemical studies have also been conducted extensively in these regions, where societies that appeared in some ways "tribal" and "egalitarian" and in others "chiefdom" were exchanging finely made ceramics and obtaining stone materials from distant sources. As our understanding of the great variability in forms of socio-political organization of egalitarian/transegalitarian/tribal/middle range societies has grown, so, too, has our understanding of equally variable and complex forms of economy and exchange. Examination of these kinds of political and economic strategies illuminates societal systems of symbolic, ritualistic, and economic value that are realized in physical form through material culture, settlement planning and layout, and even selection of locales for settlement establishment.

A brief discussion is needed regarding the *Kula* exchange system, which has been proposed by some Caribbean researchers as a model for Saladoid period exchange economies. The *Kula* ceremonial exchange of *soulava* (shell armbands) and *mwali* (red disc shell necklaces), as first described by Bronislaw Malinowski (1925), is a system of permanent and lifelong partnerships between a limited number of men, and "is rooted in myth, backed by traditional law, and surrounded with magical rites" (Malinowski 1925:85). These two groups of objects circulate through two different ring networks of trade, one outer, one inner, one clockwise, one counterclockwise; these networks link villages on particular islands. The number of partners an individual has is dependent on, and influences, his rank and status in the community; generally, though, an individual is linked to two others. The purpose of these exchanges, though, is to achieve personal status both locally and regionally. The exchange of gifts circulates through two different networks moving in different directions. There are two primary principles involved in *kula*: that the gift is repaid over time with another gift, and that equivalence of the return gift is determined by the giver, and "cannot be enforced, nor can there be any haggling" (Malinowski 1925:98). Surrounding the *Kula* are many associated activities: building and launching canoes, observing preparation taboos, etc. The building of a *Kula* voyaging canoe is controlled by the headman or chief, as is the expedition itself and the timing of the voyage itself. Additional exchanges of utilitarian goods accompany the *Kula*, but these are not ceremonial.

More recent research in the region has illustrated the dynamic but slow nature of *Kula* (Weiner 1988:146). The villages and islands involved in *Kula* exchange are not permanent but change over time, some are added while others drop out. Likewise, the locations for specialized production of the *soulava* and *mwali*, as well as the other goods exchanged during the voyage, such as pottery, ceremonial stone axes, ceremonial yams, circular boars tusks (Earle 2002:33), are also not permanent. There are many levels or forms of exchange in which people are involved, including the movement of utilitarian goods, local and long distance (voyaging) bartering and trade, and ceremonial networks. Finally, Weiner notes (1988:156) the intricate nature of the *Kula* network, where one disruption in one place can ripple throughout the entire system.

It has been proposed that the variety of forms of complicated exchange networks that exist today throughout Melanesia, Micronesia, and Polynesia, including *Kula*, are rooted in the Lapita

Cultural Complex (ca. 3,600-2,500 BP) (Kirch 1988:104). Kirch states (Kirch 1988:105) that Lapita peoples arrived in the Bismarck Archipelago around 3,600 BP, where they encountered "older Papuan populations" that had been living in the region for over 30,000 years; these Papuan peoples were already traveling overseas to obtain obsidian. As the Lapita peoples moved eastward through Melanesia and into Polynesia, different open exchange systems and networks developed. Two primary networks evolved: the Western system (Melanesia) was more closely tied with the Bismarck homeland than the Eastern system (Polynesia), which tended to replicate the original network in a new region, with community-level specialization of shell goods. Long distance systems, flowing generally from west to east, were established for obtaining and moving goods like obsidian, chert, finished metavolcanic adzes, oven stones, and ceramics. Localized exchange systems included utilitarian items, such as oven stones and clays, even though some of these materials were locally available. Kirch agrees with Green (1979) in that wide-ranging and long distance exchange systems that connected Lapita communities is evidence for complex forms of sociopolitical organization. Long distance trade was occasional. Therefore, these exchanges could be representative of continued interactions between "mother" and "daughter" communities on different islands, and were not based solely on a desire for materials.

Following models of adaptive radiation, it was proposed that as the Lapita peoples diverged from the Bismarck homeland so, too, they diverged culturally, adapting to local environments, experience, and isolation (Kirch and Green 1992). These adaptations would eventually lead to the varieties of social organizational forms and leadership, but, in general, to the patterns of "Big Man"-type societies of Melanesia and the chiefdoms of Polynesia (Kirch 1986:34).

A second example of island exchange systems are those of the Cyclades. From the late Neolithic through the Early Bronze ages, communities located on these Aegean Sea islands were interacting with each other, their neighboring Aegean islands, and the mainlands of Greece and Anatolia (Turkey); by the beginning of the second millennium B.C., they were participating in maritime trade and interaction networks that spanned from Egypt throughout the Aegean and beyond. Broodbank states (2000:9) that movement between islands was nearly constant "in order to keep life going and information flowing." Small settlements during the Early Bronze Age Cycladic of the Keros-Syros culture (ca. 2700 – 2300 B.C.) increased in number, likely by "budding off" prior to reaching each island's carrying capacity, suggesting "a very low capacity for intracommunal social organization" and individuals achieving higher social status via merit or familial membership (Broodbank 1989:321). Not all of these Cycladic settlements were necessarily equally proficient nor autonomous regarding sea travel. Smaller vessels were used for regular daily traffic, while some larger communities had long boats used for specific long-distance voyages (Broodbank 1989:331). The majority of Cycladic settlements were too small to support their own longboat crews; because of the sizes of individual settlements, efforts to coordinate the gathering of enough physical power for such a voyage could have been island-wide. Long boat voyages, powered with crews that would number over twenty-five, required communal coordination and organization. Broodbank (1993:316) proposed that larger settlements controlled maritime trade due to their ability to manipulate localized trade and monopolize long-distance voyages. The long boat cargos used in these voyages would have moved low bulk prestige goods, though the maintenance of social relations could have also spurred the undertaking of such voyages (Broodbank 1989:223). Status would have been conferred on those who could coordinate such endeavors. Centers of power developed in those communities where local trade could be manipulated and long-distance voyages could be controlled (Broodbank 1993:316). The locations of these trade centers were key not only for their position to foster interregional exchanges but also because of their central location within the Cyclades themselves.

A transportation and interaction model based on distance was proposed (Broodbank 2000). The most frequent contacts would occur within distances that could be traversed in one day, either 10 kilometers (km) one-way or 20 km round trip, at an efficient cruising speed of roughly six miles per hour. A one-way trip of 20 km could be indicative for regular but less-intensive interaction. The larger long boats used for long-distance voyages could travel up to 40 to 50 km per day, one-way. This latter category is generally regarded as the "threshold" defining local and long distance spheres of exchange.

Finally, Arnold (1992, 1995) utilized a multivariate approach to the investigation of the development of the complex societies of the Chumash chiefdoms of the southern California Channel Islands. Arnold recognized (1992:60) that both political and environmental stresses contributed to changes in social organization. The rise of elites and the development of the Chumash chiefdoms was linked to a gradual deterioration of marine resource productivity through rising sea surface temperatures (Arnold 2001). As both marine food and nonfood resources became increasingly scarce due to growing populations, social elites began to control the production and distribution of both subsistence and prestige items across the Santa Barbara Channel, like chert tools, shell beads, and plank canoes (Arnold 1992:64). "Elite ability to exercise control over the distribution of valued foods is as important as 'attached' control over production" (Arnold 1995:739; 1992). Namely, chiefs and elites controlled the production and ownership of complex plank canoes used to distribute large amounts of shell beads from the islands to the mainland. The majority of shell beads were exported from the northern Channel Islands to the mainland, as were chert microdrill tools, in exchange for mainland goods such as obsidian and steatite (Arnold 1992:67).

Arnold (1995:744) listed four fundamental criteria used to rank the importance and influence of watercraft in the development of social complexity.

1) The capacity of the vessel to move substantial amounts of cargo and/or people.

2) The difficulty and expense of building or making watercraft.

3) How much the vessel allows increased exploitation of important food and nonfood resources.

4) How much control and status is attributed to those who control or own vessels, via their ability to control the movement of foods, goods, and access to symbols of wealth and status.

In the regions discussed above, low density but open maritime networks gave way, over time, to fewer, more focused networks that apparently increased in density. The narrowing of these networks to just a few key locations along strong links would be indicative of increasingly unequal participation in exchange relations through the concentration of both the production and distribution of crafts. Over time, patterns of intra- and inter-regional interaction developed within these island networks, consisting of both intensive local links within small world networks for more frequent interactions, and more selective, long-distance associations that could be associated with the maintenance of social relations or participation in regionwide ritualistic roles, imbued with symbolic value (Broodbank 2000).

While these are well-established tenets of archaeological research utilized in the regions discussed above, little application has been made in the Caribbean and Greater Antilles save for basic settlement pattern analyses that associate site location with physical characteristics such as soil type, elevation, and slope. By combining a geochemical study of potential clay sources and developing chemical fingerprints for varieties of artifact types with a settlement pattern analysis using a geographic information system (GIS), a contextual understanding of St.Croix's ancient cultural heritage can be achieved. This dissertation is a first step in this direction, to both break out of the culture-historical and unilineal evolutionary paradigms that are still strong in Caribbean archaeology, and to serve as a theoretical baseline for future studies, both on St. Croix and throughout the Caribbean region.

METHODOLOGY

The crux of the present research is the study of complexity and processes of socio-organizational change, using as a case study systems of socio-political organization and economy of Saladoid era peoples on St. Croix. A contextual approach is utilized that builds on both complexity (systems) and functional theories, based in both shared ideologies and economic theories of exchange. As stated by Sahlins (1972:76), the economy is “not a distinct and specialized organization,” but is something that is done by people, individuals, and communities. “Economy is rather a function of the society than a structure.” This approach is used because social relations are just as important as ecological and environmental influences on how societies organize themselves and interact with others. These Saladoid societies are not pigeonholed into neoevolutionary typologies. Rather, they are conceptualized as heterarchies, defined as

> the relation of elements to one another when they are unranked or when they possess the potential for being ranked in a number of different ways….The relative importance of these community and individual power bases changes in response to the context of the inquiry and to changing values that result in the continual reranking of priorities
>
> [Crumley 1995:3].

In this dissertation, the word “tribe” is used as a common point of reference to model diachronic socio-political change for prehistoric tribal systems throughout the Caribbean, and to model variability in forms of social organization and integration (see Fowles 2002). In this sense, tribe is not viewed as an evolutionary stage or level, not a bounded entity, and not a singular form of social, political, and economic organization. “Settlement” and “community” are used interchangeably to mean villages or places of habitation, as the focus of much of this research is on settlement patterns and not the identification of specific social units that could be construed as individual communities.

Four lines of evidence are followed, which allow for a study into two analytical dimensions of structure: degrees of societal integration and interaction (Parkinson 1999). The purpose of using multiple lines is to emphasize the contention that societal changes are not caused by a prime mover, a singular causality, the exceptions being catastrophic disasters such as volcanic eruptions, tsunamis, and plagues or disease. Archaeological and ethnographic information from

Lowland Amazonia, the “homeland” for Caribbean Saladoid, is used to provide insight into other ways of knowing, to illuminate the potential variability in past human behavior. These other ways of knowing are evidenced in how people organize their world through categorization and division of space, the creation and maintenance of socio-political organizational structures. These societal structures are realized in the physical world via the organization of space, the creation of material goods, and conceptions of value and the sacred through symbolic representation, both on material goods and in myth. In many cases, these seemingly separate elements are, in fact, inseparable and inalienable. Over time, these unique forms of ways of knowing — societal organization, myth, interaction, etc. — develop through processes of ethnogenesis along unique trajectories shaped by practice, experience, and degrees of integration and interaction. For the Caribbean Saladoid peoples, these ways of knowing can be traced back to a shared cultural heritage referred to as an Arawakan Ethos (Hill 2002; Hornborg 2005; Santos-Granero 2002), a regional grouping of values, perceptions, beliefs, customs, and practices shared among communities with various kinds of socio-political organization and language, linked in a loosely-organized network. The involvement and integration of these Caribbean Saladoid peoples, and the trajectories that they create and follow through time are what is examined through these lines of evidence.

The emphasis in this dissertation, especially in regards to integration, is placed on the analysis of patterns of settlement on both local and regional scales. The fact that these are island societies — isolated yet connected — influences how these societies’ structure and means of interaction changed over time. based on the current state of information available through site reports, published papers, and the Virgin Islands archaeological site files. This analysis is based on earlier work by Hatt (1924), Morse (1989), and Vescelius (1952). A geographic information system (GIS) was built that incorporates all site location, size, and cultural affiliation information available in the Virgin Islands site files database. I then conduct a rank size distribution for all archaeological sites per chronological period and cultural affiliation. Finally, a least coast path analysis using ESRI’s ArcMap 9.2 Spatial Analyst program was conducted to investigate the possible relations between sites and their surroundings. Unfortunately, the truth about the state of archaeological information for the island is that much of the previous work has suffered from a lack of systematic, controlled field techniques and lack of publication of fieldwork and results.

The possible “roles” of early villages on St. Croix in a macroregional Arawakan system of communication and trade, spanning from Venezuela and the Guianas to Puerto Rico and eastern Hispaniola, are examined. While local environmental variations are key to the materials available to these farmer/fishers, they are nondeterministic factors in the developing varieties of socio-political forms that likely developed on and between each island. It is not assumed that islands are themselves bounded regions.

The data used for this study was based on surface surveys and archaeological excavations, is dependent on the accuracy of the data reported, and may change with additional research and field work. As mentioned earlier, there are many holes, namely in the lack of any site being completely excavated, that households have yet to be encountered *en toto*, and many sites lack radiometric dates. The categorization of site types (village, hamlet, etc.) was based on reported site sizes and compared to similar patterns of size and location found on nearby islands. While not ideal, this study does provide an insight into the preferences for and varieties of settlement location and structure, and provides more detail than previous settlement pattern studies regarding soil type, slope, hydrology, and statistical multivariate analysis of possible connections between sites.

The remaining lines of evidence are based in analyses of social methods of resource use and acquisition and local and regional exchange and interaction networks, indicative of degrees of interaction between individuals, communities, and varieties of social units. These goals are achieved through three approaches. First, previous research, including both published and unpublished, from archaeological surveys, excavations, and general collections from across the Caribbean from the Saladoid through the early Ostionoid periods are examined. This includes a preliminary, qualitative comparative study of archaeological collections housed in five institutions that was conducted from 2003 through 2006. These studies concentrated on ceramic styles and decorative elements, and the presence or absence of polished stone axes, celts, and semi-precious beads and ornaments. These collections were: the Gudmond Hatt collection, housed at the Danish National Museum, Copenhagen, Denmark; the Krieger Collection, housed at the Smithsonian Institution Museum of Natural History, Washington, D.C.; the de Booy collection, housed at the National Museum of the American Indian, Washington, D.C.; the Folmer Andersen Collection, housed at Christiansted National Historic Site, Christiansted, St. Croix, U.S. Virgin Islands; and the Vescelius Collection, housed at the Peabody Museum, Yale University. The collections were photographed digitally, and copies of the museum inventories and descriptions were made and studied. The materials and manufacturing methods used to produce these items were recorded, and comparisons are made between those objects associated with the production of goods and similar artifacts recovered from other Saladoid period Caribbean archaeological sites in the region, as listed in databases, artifact inventories, and published reports.

It is held that refined and decorated pottery, such as WOR and ZIC wares, and finely carved and ground stone ornaments, celts, and axes made from semi-precious, non-local stones are indicative of processes of specialized craft production. Symbolic value is often expressed through iconography and the lengths to which a particular material, whether finished or still in its raw state, is obtained. Factors that affect the social value of a good include the rareness of the raw material, the labor required to produce the final product, the identities of the producer, distributor, and consumer, and the symbolic meaning of the finished product. In the production of valued prestige goods, status is often attributed to the artisans with the skills to produce such items, as well as to those responsible for coordinating the production and transportation of both the raw material and the finished product from source to manufacturing center to final destination. The ability to organize and coordinate maritime activities would be associated with knowledge of the foreign, and this knowledge of the exotic could itself become a commodity realized in increased social status.

Second, a preliminary comparative geochemical compositional study of samples of Saladoid period pottery sherds and local clays that could have been used to make these ceramics was conducted using neutron activation analysis (NAA). The selected ceramic sherds, spanning the Saladoid to the Early Ostionoid periods, are representative of a variety of styles and manufacturing quality, ranging from thin, highly fired wares to thicker, coarse wares, plain and decorated wares, and griddles. Eleven samples of local clays were collected from guts located near known prehistoric archaeological sites, and were also tested. These tests were conducted by the University of Missouri Research Reactor Center (MURR), who has conducted the majority of NAA studies on Caribbean pottery, and maintains a database for comparative study. These sherds and clay samples were also selected for petrographic analysis via a qualitative inspection of minerals in thin section with a cross-polarizing microscope; this analysis is ongoing, and will be presented in future publications.

The purpose for the NAA study was to potentially identify acquisition locales for clays, sources of origin for tempering materials and slips, all of which are indicative of choice and selection of particular resources, a topic that recently has become a focus of much research (Arnold 1985; Costin 2001; Rice 2006; Stark 2000). It has long been assumed that potters select clays closest to their homes or places of production. Through ethnoarchaeological studies, however, it is known that potters will travel up to seven km to obtain clays, 24 km for tempering agents, and up to 250 km for slips and glazes, in some cases even up to 800 km (Arnold 1989; Rice 2006). The catchment areas for most resources used in pottery production, however, is generally held to be within seven km, and the majority of studies have found that most clays and tempering agents are obtained within one km of a community (Rice 2006:116). Besides natural availability of clays and tempering agents, social factors also come into play in regards to procurement strategies. These include control of access to resources, political and kinship relations between the potter and the resource controller, social boundaries, and cultural meanings and rules regarding vessel construction for ritual or ceremonial use.

Finally, a geochemical analysis of polished groundstone celts and axes, carved beads and ornaments, and pieces of raw, unworked stone excavated and collected from several archaeological sites across St. Croix is conducted, using a scanning electron microscope (SEM), with a back-scattered electron detector (BSE), a PGT-Imix energy-dispersive X-ray spectrometric analyzer (EDS), and electron microprobe. These artifacts are the most cited evidence for the presence of long distance networks of interisland exchange, not including individual observations of carved freshwater naiad shells and the obvious communication links evidenced by uniformity in Early Saladoid well-made and presumably ceremonial ceramics. A geochemical analysis of stone objects of both carved ornaments and polished groundstone celts. As in the pottery study, these objects are compared to the results of previous studies conducted at the American Museum of Natural History (New York) for sources of similar stone materials and ornaments found elsewhere in the Caribbean, in an attempt to identify potential locations of origin.

The examination of refined ceramics, and ornaments, celts, and axes carved and ground of non-local semi-precious stone are used to discuss social interaction and organization via proposed exchange networks. In this dissertation, these objects are viewed as evidence of varying levels of craft production and exchange, an activity that is significant and influential in the creation, functioning, and maintenance of sociopolitical structures. The continuity of refined pottery styles for roughly 500 to 1,000 years is not just indicative of a physical migration and diffusion of a people, but illustrative of broad networks of interaction, communication, and exchange of information and goods that maintained and perpetuated knowledge and traditions of methods of pottery production and decoration. They also represent continued efforts toward the maintenance and “passing down” of knowledge of long distance networks of resource acquisition. Over time, there was a gradual divergence of styles into regionalized traditions that developed within growing local and regional interaction spheres.

Studies of the movement of stone goods throughout the Pacific Islands, especially during the Lapita period, have indicated that lines of communication and exchange are often maintained in order to establish and maintain social relations loaded with symbolic and cultural value.

Communities and villages that have as residents well-connected people of status, and access to goods and reliable resources will likely become nodes in networks of interaction, communication, and exchange. Status is achieved, the ability to control natural materials and harness sacred power embedded in them through transforming raw material into a finished product, as well as the ability to conduct long distance voyages and control knowledge of the foreign. In this way, the production of goods and materials is realized on the physical landscape in patterns of settlement, interaction, and resource acquisition, though possibly existing simultaneously in contemporaneous systems (economic, political religious, etc.).

RESEARCH OBJECTIVES

This dissertation investigates the potential variability of forms of socio-political organization among so-called tribal communities, and questions and definitions of complexity will be addressed by examining old assumptions of Saladoid-Caribbean peoples as simply “egalitarian societies.” In particular, the research will demonstrate patterns of contact and exchange between island societies by examining the social dynamics and political structures of the peoples of St. Croix within the larger Greater Antilles and northern Leeward Island interaction sphere from the Saladoid (ca. 400 B.C. – A.D. 600) through the Early Ostionoid (ca. A.D. 600 – 900) periods. These patterns are illustrated through the analysis of settlement patterns and artifacts associated with craft production, namely finely made ceramics, ceremonial and polished stone celts, and carved stone ornaments and beads made of nonlocal materials. St. Croix was selected as a case study for several reasons, first and foremost being accessibility to data. St. Croix is a territory of the United States, and two of the main sites that are discussed, the Salt River and Judith’s Fancy archaeological sites, are managed by U.S. National Park Service; they both lie within the boundaries of Salt River Bay National Historic Site and Ecological Preserve. The National Park Service (NPS) also houses the Folmer Andersen Collection of prehistoric artifacts, which was used for two components of this research.

A model for Saladoid exchange economy is proposed, using theories of practice and complexity and Complex Adaptive Systems (CAS) models. It is argued that complexity theory, with a CAS and small worlds approach, can provide a framework for understanding how local interaction and experience, over time, can affect an entire system, and serves as the basis for examining questions of processes of diachronic change in socio-political strategies. Following Hirth’s (1984) model for gateways and dendritic exchange systems, Kirch’s (1988, 1991) “lifeline model" for Melanesia and Oceania, and Broodbank's model (1993, 2000) for short versus long distance voyaging, I propose three scales of interaction: 1) direct access to goods and local exchange, 2) medium distance exchange relationships, or what could be traversed in a day or two (40-100 km) in one direction, and 3) long distance voyaging covering hundreds or even thousands of kilometers (Spencer 1987). Over time, the long distance networks began to decay in favor of regional systems, or small worlds, of exchange, with "hubs" developing at particular locales. This model incorporates both environmental and cultural factors, and recognizes that small changes and interactions on the level of the individual may impact outcomes throughout a system, sometimes having little effect, sometimes resulting in avalanches of change.

Included is a discussion of changing perceptions of complexity and definitions of the "tribe" and definitions as they relate to the organization of a society's economy and subsequent socio-political organization. There would have been localized control over daily activities and some production, such as growing manioc, fishing, managing trade and exchange, etc., that varied from village by village, island by island. There was enough regional communication and interaction to perpetuate established belief systems and their material manifestations – skillfully made and decorated pottery, semi-precious ornaments and beads, carved shell ornaments and other objects, and probably perishable goods like feathers and foods – to argue for some degree of coordinated and organized activities on micro- and possibly macroregional scales. It is posited that the core of Early Ceramic Saladoid social organization was present prior to their migration from South America as a part of a macroregional Arawakan "ethos" that spanned across different language groups and cultures (Hornborg 2005).

In this study the following questions are addressed:

- What forms of socio-political organization were utilized by the Saladoid period peoples on St. Croix?
- Are changes in artifact decorative style and technology, and patterns of settlement indicative of localized expressions of regional changes and trends at the end of the Saladoid period on St. Croix?

And, on a regional scale:

- What roles do exchange systems play in island colonization and settlement and the maintenance of social relations and changes in organizational structures, especially along archipelagos that can be tied to a "homeland?"
- How do these roles change over time, as "colonies" transition into established settlements?

In Chapter 2, the current state of theories and arguments surrounding models and assumptions of tribal or Middle Range societies is presented. I also discuss the impacts of various theoretical models exchange and interaction systems, as well as problems associated with each. The focus is on models of interaction and exchange from a practice and complexity perspective.

In Chapter 3, the environmental, geological and geomorphological settings, and the cultural history of the prehistoric Caribbean is discussed. The present the current state of knowledge of Lowland Amazonian social organization and interaction of Amerindian groups, from both ethnographic and archaeological data is also presented. This information is used analogously to posit the possible variable forms of socio-political organization that could have existed, in addition to illuminating the variable and flexible nature of organizational forms that exist within tribal societies.

In Chapter 4, I discuss the present state of archaeological research on St. Croix, and the settlement pattern analysis is conducted.

In Chapter 5, the current knowledge of Saladoid period interaction and exchange systems across the Caribbean is presented, based on a study of stylistic attributes found on ceramics and carved stone ornaments housed in several collections.

Finally, these various components are pulled together in Chapter 6, and a model of economic exchange, social organization, and diachronic change for the Saladoid through Early Ostionoid periods is presented. The model is qualified with the following caveats: that the data presented for St. Croix may be altered as new excavations are undertaken, especially with development increasing on the island; that the identification of new sites may alter these results; and that problems, inaccuracies, and/or mistakes in the existing data could have skewed the results.

CHAPTER 2

TRIBAL ECONOMY AND COMPLEXITY

INTRODUCTION

Previous studies of Saladoid social organization, political economy, and interaction spheres have typically fallen into two camps. The first, and oldest, simply states that Saladoid societies (or people living in the Saladoid cultural phase) were egalitarian, demonstrating broad regional social contacts and long distance interaction and exchange evidenced by similarities in pottery styles and decorative elements.

The second camp contends that Saladoid societies were “complex tribes,” a form of social organization existing in some undefined intermediate stage of development between the evolutionary levels of tribe and chiefdom. Some of these researchers (Boomert 2000a; Curet 2003; Hoogland 1996; Roe 1989; Siegel 1999, 1989) have gone further, stating that Saladoid peoples had forms of socio-political organization similar to Big Man forms of middle range societies. This group has begun to address problems inherent in assuming egalitarianism in societies that demonstrate little overt archaeological evidence for social hierarchy (i.e. elaborate elite burials, monumental architecture, differential settlement patterns, etc.)

Likewise, there are two general categories into which explanations of socio-political and organizational changes at the end of the Saladoid period fall (Curet 1992). The first are the adaptationists, who contend that social complexity (i.e. the development of institutionalized hereditary hierarchy and social inequality) arose because of population pressure and environmental settings and the availability of circumscribed resources. When a critical point is reached, such as when resources are strained and populations rise beyond a carrying capacity, societies become hierarchical and individuals rise to power as managers of these resources, commonly referred to as “chiefs.”

The second are political economists, who explain culture change and increasing levels of institutionalized social inequality as the result of internal political maneuverings of individuals (“entrepreneurs”) seeking to increase their own prestige via manipulation, competition, and conflict. Societies become stratified as these individuals build constituencies and support networks and eventually an elite and ruler class developed. Populations then grew and placed more demands on available resources. Additionally, the study of political economy as the control of scarce resources and goods has been used by archaeologists as the basis for studies of the development of socio-political complexity (Hirth 1996:205). Political economy is not solely the process of accumulating goods and resources, but is comprised of distribution, political organization, consumption, and social development.

Both of these perspectives contend that societies can be classified into observable sets of characteristics or attributes, via artifacts and their distribution on the landscape, based on the form of organization and transitions from one to another. These traits are comparable to living societies and hypothetically fit into categories established for observed social behavior and organization. As will be discussed, there are problems with discretely associating a society with a trait list of cultural and material characteristics, though they may be used for ease of description and analysis.

The reality, however, is somewhere in between. Societies do not develop hierarchies, ranks, and status levels if underlying "seeds" are not already in place. For this reason, it is necessary to examine the concepts of egalitarianism and complexity (Curet 2003). In this chapter, I address these issues via a theoretical discussion of tribal societies and their traditionally associated "traits," and the problems of using these traits as means of categorization. Variables in tribal social organization that include conceptions of political economy, value, and exchange are discussed in reference to island societies, as the conditions under which survival and interaction are experienced on and between islands present unique challenges. Theories of exchange and gifting in relation to specialized production of goods used in such exchanges are also presented. Processes of social change are described using a variety of models of settlement, interaction, and exchange from cultural geography, in order to set the stage for developing a model of interaction and exchange for the Saladoid Caribbean. Finally, I present an argument for conceptualizing tribal societies in the Saladoid Caribbean in terms of heterarchy, and as possible House societies. House societies incorporate the dynamic and variable nature of systems of societal organization for those groups that demonstrate typical "tribal" traits in conjunction with the symbolic and cosmological importance of house and village layout and placement in the landscape in group identity (Gillespie 2000a; González-Ruibal 2006:1444; Heckenberger et al. 1999; Siegel 1996, 1992).

The goal of this chapter is to illustrate the relationships between environmental and cognitive systems of how societies organize their worlds. Societies are complex wholes and integrated systems, not just series of traits. All aspects are interdependent on each other such that change in one element leads to changes in others. Religion, and conceptions of the sacred and valuable, are reproduced in the symbolism materialized in high value and prestige goods, and on the landscape itself through the construction and layout of houses and villages and the locations selected for their placement. These factors both influence and are influenced by their surroundings.

TRIBALIZATION AND MIDDLE RANGE SOCIETIES: PROBLEMS OF CATEGORIZATION

Many of the models for social organization and change are evolutionary in scope, and hold that tribal societies are transitional stages between the band and the chiefdom. Tribes have been customarily viewed as semi-sedentary or sedentary, egalitarian, self-sufficient, and socially and geographically bounded (i.e. segmented) communities (Anderson 2002; Braun and Plog 1982; Carneiro 2002; Creamer and Haas 1985; Fowles 2002; McGuire and Saitta 1996; Parkinson 2002a, 2002b). The subdivision of structural and organizational elements into traits is inadequate when accounting for the historical trajectories that define and shape a particular society. Equality may exist in societies in particular contexts as stabilizing mechanisms when power shifts too far in one direction in recognized hierarchical societies. As stated by Flanagan (1989:262), "even rigidly hierarchical systems may contain egalitarian subsystems, just as so-called egalitarian systems may contain insidious hierarchies."

The Tribal Trait List

Subsistence and Settlement

Tribal societies are routinely affiliated with hunting and gathering subsistence strategies (Creamer and Haas 1985). While some intentional production of foodstuffs may have been practiced in the form of swidden agriculture, the depletion of soils is often cited as a causative agent in keeping tribes on the move (Meggers 1971). Tribal societies produce a limited surplus of subsistence goods not to support centralized political structures or labor specialization but to consume within the local community and as security against unforeseen emergencies.

Many tribal societies live in highly productive areas like ecotones (convergences between two or more ecological zones, including watersheds, estuaries, and mangroves) that while not necessarily amenable to surplus agricultural production could provide enough of a reliable subsistence base to foster the development of part-time craft specialists, social hierarchies, and even complex exchange systems (Russo 1988; Yesner 1980). Study of complex hunter-gatherers has proven that the domestication of plants and animals is not a necessary factor in the emergence of institutionalized social inequality (Sassaman 2004). Movement across the landscape could have been instigated by the search for specific foods, like seasonally available shellfish, fish, sea turtles, and birds. As some resources are overexploited new resources are introduced to the subsistence economy, and preferences for different animal and plant foods change accordingly. When coupled with root crop horticulture such as manioc, which can be stored as surplus for up to a year, and home gardening, such a wide-ranging subsistence base could have supported societies with growing populations and increasingly hierarchical social structures.

Two basic types of settlement pattern are typically associated with tribal societies: the nucleated (circular) village and the hamlet. Where people live along a coast or river, villages are often linear (Denevan 1996). Tribal settlement patterns, unlike those of chiefdoms, purportedly do not demonstrate any hierarchy (i.e. hamlet to village to larger population or ceremonial centers) (Earle 1987).

Big Man Collectivities

The tribal form of social organization is normally regarded as egalitarian, but within each community various forms of ranking or non-institutionalized status may be present (Creamer and Haas 1985; Fried 1967). These societies often participate in limited long-distance trade, largely based on village-level specialized production of some good (Carneiro 2002). Big Man Collectivity models of socio-political organization are often cited in the ethnographic literature for tribal societies, especially in regards to those of the Caribbean prehistoric Saladoid period. The classic definition of a Big Man, as conceptualized by Sahlins (1968) describes the leader as an ambitious, competitive social climber, who yearns for status and builds factions comprised namely of kin and households. Status is gained by holding and sponsoring large public feasts in order to shame other contenders and competitors for power into subordination. The Big Man becomes the equivalent to a regional-level village leader who maintains high social status based on his skill and ability to direct religious ceremonies, acquire and distribute goods, to act as representative at important meetings and functions, and mobilize people within a region or group of villages for specific tasks or occasions. They act as political and economic “brokers,” and status is maintained through charisma, economic control, and political leadership. The Big Man position is achieved entirely on ability and is therefore not like a chief who inherits his or her position based on heredity. They are a kind of regional politician and organizer, but have no inherently-granted authority or power to impose punishments or to enforce their decisions. An extraordinarily successful Big Man may ultimately acquire enough influence to pass on their leadership position to their descendants. Big Man societies are thus often viewed as a stage leading to the development of hierarchical societies where political control is passed on to the next generation primarily on the basis of birthright. According to Sahlins (1972), chiefs emerge as managers of complex systems of production, and their role as redistributors maintains and builds their power.

Arnold (1995, 1992) presents Big Men as individuals who obtain control over labor for a variety of reasons, such as the large-scale processing of resources for storage or feasting, cooperative production and harvest of seasonally abundant resources, and directing capital investments (e.g. the construction of watercrafts, ceremonial or religious centers and monuments, and large-scale land-moving endeavors [mounds, canals, etc]). However, where Arnold views the "prime mover" for change from more complex forms of egalitarian society to chiefdoms as the control and manipulation of labor for the common good, the concept itself is still presented as a developmental or transitional evolutionary stage. Social and economic organization is, in fact, interdependent, and change is not simply a transition from one ideal type to another (O'Shea and Barker 1996:15).

This conception of Big Men as "competitive social climbers" has been perpetuated over the last several decades based on stereotypes of hereditary versus achieved rank, especially in regards to Polynesian chiefdoms versus Melanesian Big Men (Terrell 1986:197). Polynesian leaders are described in anthropological literature as hereditary chiefs, while Melanesian leaders are said to rise to this same rank via competitive feasting. Terrell has noted (Terrell 1986) that the definition of *bikpela man* is actually "adult, headman of a village, man of influence and authority." These stereotypes were attributed to all Melanesians on the basis of studies of only a handful of island societies, and generalized to fit the entire region. Early studies, though, cite the public service or "goodness" associated with generosity, trustworthiness, and cooperation, as equally important as ambition, skill, and industriousness (Terrell 1986:202). The Big Man also acts in service to the public by promoting societal interests. Power becomes based on the leader's skills and ability to foster effective exchanges for the best of the community (Bell 1991:166). Leaders strengthen relationships with neighbors by creating alliances, trade and exchange relations, and by resolving disputes. These relationships are not confined to those communities within the same language or cultural area, often spanning language barriers (Terrell 1986:204).

There is actually great variability in regards to context-dependent forms of social organization and leadership. For example, Godelier (1999) describes the differences between Big Men and Great Men. Only Great Men obtain power and wealth by holding the "inherited powers present n the sacred objects and secret knowledge given to their ancestors by non-human divinities" (Godelier 1999:8); in other words, they command the supernatural. Brown (1990:101) describes the Strong Men of Highland New Guinea as managers and coordinators of food production for large-scale exchanges in addition to their skills as successful war leaders. Finally, Redmond's (1998:3) concept of short-term chieftaincy is defined as "a situational hierarchy occurring from time to time among nonhierarchical, uncentralized tribal societies." The chieftain, like the Big Man, creates regional alliances and can achieve regional recognition and prestige, in addition to overseeing ritual and religious activities. The benefits of effective leadership include aid in food and other subsistence items during times of stress, the fostering of social and exchange alliances for utilitarian and prestige goods and protection in warfare. Children of these chieftains, especially the eldest sons, can become members of a new rank of social elites and build an ancestry that over time become self-legitimizing. In some cases, these elite ranks become inherited positions, and members have access to knowledge and goods. If this trend continues, leadership and status become institutionalized societal roles (Redmond 1998:12).

Blanton and others (1996) define a dual processual model in which two main forms of political strategies are identified that are not necessarily confined to particular forms of political organization and economy but exist along a continuum. Network strategies are based on individual-centered, extra-local exchange and social relations. Power, and possibly leadership, can develop from these relations due to an individual's exclusive control of some good, its exchange and movement through a region, and their ability to divert those goods (or knowledge, etc.) from competitors.

Corporate strategies, on the other hand, employ power sharing in order to prevent exclusive control of resources, knowledge, and power by a few (Blanton et al. 1996:2). Corporate solidarity is emphasized but this does not mean that leaders do not exist; in these cases, there is an interdependence between the leader and the rest of the populace, between subgroups in the population, that use communal ritual and ceremony and comparative egalitarianism to prevent the rise of powerful individuals. Leaders are able to determine rights of use but not to alienate resources. Corporate chiefdoms build on their landscapes, mobilizing labor to build monumental works, and group identity is mapped onto the landscape via these monumental works. Production of crafted goods would not necessarily be centralized, and could appear diffuse on the landscape, while consumption would "be focused at points of group articulation" (Peregrine 2001:37). Group membership is emphasized in death with burials placed in cemeteries. Leaders of corporate chiefdoms are often not buried with prestige goods marking their status

Based on the above discussion, there is a staggering amount of diversity in the political forms possible among middle range societies. Some are more centralized politically that others, some have more hereditary and hierarchical forms of societal differentiation and others more ranked. Even Sahlins noted (1972:209) that some Big Man systems could be more centralized than some chiefdoms. What is apparent is the fluidity that exists within the traditional dichotomy between egalitarianism and complexity, between achieved and ascribed leadership, between formal inherited status and rank.

Tribal Economy and Conceptions of Value

Tribal societies are associated with both reciprocal and redistributive forms of economy and exchange, depending on the specific form of political organization utilized (i.e. whether or not they were centrally organized).

Economy is defined here as a system of production and distribution that incorporates several complementary and inseparable components, including resource environment, technology, production organization, the utility and value of goods, and factors governing their distribution (Hirth 1984). Gregory (1982:7) defines economy as "the analysis of consumer behavior under conditions of unlimited wants and limited resources." In Western capitalist economic systems, this behavior is driven by the desire to produce surplus through the minimization of expended energy and the maximization of product, accomplished through the objectification of the commodity being produced and exchanged. People are alienated from the products they produce. Value is imposed via the exchange of commodities. As labor is commoditized (fetishized), it develops use-value, and are imbued with exchange value. In this way, social relations are fetishized while appearing to be exchanges of things.

Formalist economic models are not easily applied in non-Western economic systems where a thing or object is inalienable, not disassociated from its producer, its original owner, and source of origin. Value is not solely based on the scarcity of the raw material, time, labor, and skill of the producer, and the costs of transportation, acquisition and manufacture, but includes the relationships it represents between procurer, producer, transporter, and consumer (Gregory 1982:19). Therefore, the value of an object is defined by the material itself, the skill required for its acquisition in raw form, manufacture and production into a finished product, skill and knowledge required for its transportation to and from communities, its individual history and history of ownership (inalienability), the social relationship it represents, and the symbolism of a finished product. This perspective is the basis of the substantivists' school, as based in the works of Polanyi, Bohannan, and Sahlins, among others.

Mauss' (1925) description and analysis of gift societies illustrated two basic kinds of social-economic relations: gift and commodity. One of the primary differences was the alienability of objects in commodity economies, while in gifting economies objects are inalienable. The act of gifting both decreased the distance between participants in the transaction through sharing, but increased the social distance by creating debt. The relationship becomes hierarchical in that the debtor has become obligated to "gift" in return. Gifts between ranks in a society have different meanings than those given within ranks, for similar reasons.

Polanyi (1944), recognizing that modern economic theory could not be used to describe non-Western societies, described four general patterns of economic systems: reciprocal, redistributive, market exchange systems, and householding. He related reciprocal and redistributive economies to particular forms of socio-political organization, namely tribal and chiefdom/state societies, respectively.

Sahlins (1972:191-196) argued that reciprocity exists along a continuum, from the pure gift (generalized reciprocity) to gifts with the expectation of a return (balanced reciprocity) to the desire of receiving a gift with no intention of return (negative reciprocity). Generalized reciprocity is presented as a tool when individuals seek to build a name within a community, to become leaders or "Big Men" (1972:208). These systems of reciprocities can be centralized, and may develop into customs and duties as assumed by societal rank. These ranks are secured via generous acts that, over time, develop into conceptions of being "noble" (1972:206).

Bohannan (1955), and later Gregory (1982), understood that multiple spheres of exchange exist simultaneously among cultures with gift economies, or economies in which objects and things are personified, not objectified. Objects are ranked hierarchically, depending upon many factors that include social status of both consumer and producer, and sometimes that of the transporter, and the necessity of the object itself, whether for physical survival, the continuation of belief systems, or the maintenance of social relations. Bohannan (1955) notes three general ranked spheres of exchange that exist among the Tiv: the lowest rank consisted of subsistence goods, the middle rank of prestige items, and the highest included non-subsistence items and those imbued with sacred meaning. The degrees to which objects are ranked and valued are dependent upon individual cultures, but there are general trends regarding their exchange. Exchange within ranks is referred to as conveyance. There is normally little to no exchange of objects between ranks, a process Bohannan (1955, 1959) and Piot (1991) call conversion; when conversion occurs, it most often moves up in the system, so an object tends to increase its value when exchanged. Piot expanded this concept to include an emphasis on relational over product spheres of exchange. Objects are converted into relationships, and these relationships are then fostered through further exchanges and gifts of goods. Therefore, several economies may exist simultaneously within a community and region. These economies can include subsistence, reciprocal exchange, and sacred.

There are several main characteristics of highly-valued or prestige objects that, over time, come to symbolize wealth and social hierarchy (Godelier 1999:161-165). Weiner first noted that among valuables that are exchanged, there are some things that must be kept and others that can be given away (Godelier 1999:33). Those things that are kept are valuables, knowledge, rites, etc., that identify a particular group from another; they are the things of greatest symbolic value. These differences in identity constitute a hierarchy that incorporates their production and reproduction.

Some of the characteristics of highly valued objects include:

1) The object must have no practical use and is not used in daily activities (hunting, planting, etc.). In the Caribbean this would include carved stone and shell amulets, polished groundstone axes and celts, and finely crafted and decorated ceramics.

2) The object must be abstract in its symbolic representation. It must be disconnected from daily life in order to "embody" the social relations they represent, to both the participants and members of the community and to outsiders. In other words, it must be representative of group identity and membership.

3) The object must be culturally and symbolically beautiful. These exchange objects are modified and worked, and its value is based on its exchangeability for other objects in the same rank or higher ranks. The ability to capture the aesthetically beautiful and transform into material form is identified by Helms (1993:67) as societal reinforcement of conceptions of morality; only a moral person could produce an object that is believed to be beautiful.

4) The object must provide or imbue special powers and knowledge often attributed to life and/or death, and in turn be representative of this knowledge.

An object is attributed sacred status when it is representative of exchanges not between the living and living, but between the living and dead, the spiritual, the unseen. The realm of the sacred exchange is one between people and their origins (Godelier 1999:171). The role of the myth is to explain these origins, and to provide legitimacy for the order prescribed by a given cultural system. Sacred objects are inalienable and their value cannot be removed, they are not traded or given away; precious objects, on the other hand, can be traded or exchanged within their sphere. Therefore, sacred objects exist outside the realm of circulation. Those who make or produce sacred objects also have the abilities and skills to control the supernatural. When a person becomes the owner of a sacred object they acquire its inalienable powers and prestige, while simultaneously imparting their own identity onto it. Stewardship or ownership implies control, thus implying spiritual power that legitimizes control over those people who do not control spiritual power.

In sum, economy and definitions of value, while not a cause of social stratification and ranking, provide some of the parameters within which ranking can develop. Value, in this case, can be defined as "the social principles of wealth and reproduction by which one organizes relationships between things and human beings" (Uzendoski 2005:234).

Crafting and the Specialized Production of Goods

Like models for socio-political change, discussions of exchange and craft specialization are often grouped into several theoretical camps: adaptationist, political, and commercial development (modern economic theory; Brumfiel and Earle 1987:1). In adaptationist models, crafting and production of goods is viewed as the result of elites and leaders becoming economic managers, controlling access to resources, managing production and exchange, and redistributing subsistence and/or elite goods for the overall good of the people. In political models, leaders, not the populace, are the recipients of organized, centralized production and exchange, the purpose of which is to accumulate power, status, and wealth.

Costin (2007:146) defines crafts and the process of craft production as "any transformational process involving skill (knowledge, talent/proficiency, effort, aesthetics, and cultural meaning." She identifies production as a system comprised of six components: "artisans, means of production, spatial and social organization, finished goods, principles and mechanisms of distribution, and consumers" (Costin 2000:377-378). Viveiros de Castro (2004:477) identifies production as the "imposition of mental design on inert, formless matter." Exchange spurs production, "since, without the proper social relations…no production is possible" (Viveiros de Castro 2004:478).

Modes of production in tribal societies are often divided into household, kin-based, community, and workshop forms. Household production is found in most communities, but not in every house within a community. Production at the household level would be difficult to maintain during times when other tasks, such as gathering, fishing, or tending or harvesting crops, were occurring. This argues for possibly seasonal organization of production of goods (Hagstrum 2001:51). Workshops are more specialized, with particular places or locales of production that are outside the home. Production of finely crafted valued goods among tribal or middle-range societies is commonly viewed as a part-time endeavor (Carneiro 2002). Full-time specialization is typically associated with very centrally organized political forms with institutionalized, hereditary status hierarchies (e.g. complex chiefdoms, states).

There are different kinds of specialization that go beyond the amount of time dedication to production, namely product and producer specialization (Costin 2007:3). Regarding product specialization, the crafter or producer has stopped conducting subsistence activities to concentrate on creating specific goods. The product itself is specialized, and made for nondependent individuals outside of one's household. Producer specialization, on the other hand, is the restriction of productions to a few individuals who demonstrate high skill levels. Exchange is dependent on the specialized activities and skills of the individual.

Links between specialized craft production and the rise or emergence of elites and hierarchical status have been traditionally viewed as either a response by management to offset environmental risk or personal status-gaining activities of individuals (Peregrine 1991). Many times, the connections between rising elites and craft specialization are based in political strategies of those elites seeking to increase their power by controlling production, thus access, to symbolically valuable goods. Researchers have divided the affiliation of specialists into two categories, attached and independent, depending on forms of political organization. Attached specialists produce goods to meet the personal and political needs of patrons and elites, and are typically designated as lower-class artisans, while independent specialists produce goods for a variety of reasons and a variety of people (Brumfiel and Earle 1987:5).

Spielman posits (1998:158) three general kinds of craft specialists present in middle range societies. She equates open ritual performance (equal access for all) with independent specialists.

In societies where status can be achieved through ritual knowledge and performance, the craft specialist may or may not also be the ritual specialist. Finally, where ritual knowledge is a critical factor in obtaining status, the craft specialist will most likely be the ritual specialist. In these cases, the importance of the ritual mode of production of crafted objects cannot be stressed enough; the participation of individuals and communities in ritual and ceremonial events, like feasts, is an important reason for increasing economic production of valued, ritual objects (Spielmann 2002:195). The ritual cycle regulates food production and acquisition and the organization of communal labor, and provides context for interaction, distribution, and consumption.

The identities of specialists have often been attributed by researchers as lower-status, the act of crafting created out of necessity, not choice. In these cases, artisans are often treated as outcasts, especially if the skill requires manual labor (Helms 1993:52-53). This follows the adaptationist perspective of crafting arising as a specialization when certain individuals or groups do not have access to subsistence goods. It can also infer that the good was produced for the express desire of elites to enhance status and assert political power and authority.

Helms (1993:52) presents evidence that skilled crafts producers are often held in high status. Recent work and comparisons with ethnographies have demonstrated that in many cases artisans are members of elite ranks. Ames (1995) has argued for the existence of embedded specialists among Pacific Northwest societies, where specialists are integral parts of households and of household economies; embedded specialists are defined as those who work for households to which they belong. Their role is defined by kinship, not economics or class (Inomata 2001). For many "egalitarian" or non-politically centralized societies, the "qualities and values associated with skilled crafting are fundamental…to the role of political leadership" (Helms 1993:70). These qualities include those of the "ideal man," described earlier in this chapter in regards to Big Man collectivities.

Social power and status can also be relegated to those responsible for and involved with the transportation of both raw material and finished product, like traders, community leaders, navigators, and canoe builders (Arnold 1995; Broodbank 2000: 247; 1998:316; Helms 1993:43, 96-99; Schortman and Urban 2004; Watters and Rouse 1989; Wilbert 1993; Yesner 1980). The ability to successfully travel, navigate, and coordinate voyages, and to oversee vessel construction is associated with knowledge of the foreign, and this knowledge can itself become a commodity realized in increased social status. Knowledge of far away places, often times regarded as "primordial places of origin" or ancestral homelands, and the ability to obtain goods that represent these social connections demonstrates control of the unknown, of the mythic, of even the supernatural. Among Kayan societies of central Borneo, early hereditary chiefs “were the organizers of migrations,” and the role of leadership itself became a specialization in the skill necessary to represent a community to others (Rousseau 2001:122). Additionally, control over goods can be maintained via control over transportation, especially when specialized technology is needed.

Control over knowledge is yet another way to establish and maintain status and inequality (Lindstrom 1984). Types of knowledge include “magical and medical recipes, details of land tenure, plot names and boundaries, genealogical and group alliance history, and ritual decorum,” among other things (Lindstrom 1984:294). This is true for Big Men of Melanesia and crafters alike. Status is often attributed to the individual’s ability to control the unseen, to transform the intangibles of social and cosmic order into material form, based on the characteristics of prestige objects discussed above (Spielmann 2002).

Through conscious effort knowledge, ideas, and goods are exchanged and passed to others, sometimes over long distances. In the production of valued prestige goods, status is often attributed to the artisans with the skills and ability to produce symbolically and religiously items that are demonstrable expressions of spiritual power. These “socially valued goods” are created to establish and maintain individual social relations and to fulfill individual and community ritual obligations in networks. Symbolic significance (value) can be expressed on these goods through iconography, especially when widely distributed, or through the location of production, or from the original location of the raw material (Helms 1993; Spielmann 2002).

Problems with Categorization and Definition

Egalitarian status is typically attributed when a selected set of traits (material culture, settlement pattern, and ethnohistorical accounts, among others) assigned by an archaeologist are not observed. In other words, egalitarianism is assigned by default to those societies that do not overtly demonstrate traits used when defining status, inequality, or “complexity,” whether in burials, or patterns of settlement patterns and/or trash disposal. This is the definition that has been employed in archaeological contexts, evidenced by the absence of prestige goods, monumental architecture, and changes in the landscape that could accommodate the production of agricultural surplus. As stated by Flanagan (1989:245), the “neglect of the structure of egalitarian systems is due, at least in part, to the acceptance of a general evolutionary model that postulates a primeval egalitarian community." While it has long been recognized that truly egalitarian societies do not exist (Sahlins 1958), the label remains attached to many non-Western and ancient societies that do not meet the established criteria presented above. Societies and communities that may, on the surface, appear to be comprised of equal opportunities for its members to acquire status and access resources may actually have had inequalities that were realized in a number of realms: access to knowledge, objects of symbolic and ritualistic value, and even material goods (or commodities). "Few, if any, societies are without some form of domination, whether it is based on age, gender, kinship, or some more institutionalized form of domination" (Hendricks 1988:217).

These 'criteria' or traits have come under criticism for not taking into account the dynamic nature and variability of tribal societies (Curet 2003; Fowles 2002; Parkinson 2002a). The traditional view of tribes as an evolutionary developmental stage between band and chiefdom has been supplanted with more fluid models that illustrate variability and innovation. Changes in social organization and complexity can be viewed as cyclical series of historically defined trajectories that fluctuate over time between increasing and decreasing organizational complexity, depending on a variety of changing needs and circumstances. It is perhaps more useful to conceive of societies as "bundles of organizational options that are drawn upon to meet changing needs over time" (Fowles 2002:21).

Recent work in the Chaco Canyon region illustrates how ill-defined concepts of "complexity" may mask the multivariate roles of production, consumption, and exchange, and how these systems can only be understood holistically. Previous interpretations of the grand architecture and differential placement of prestige goods at Chaco, especially those goods associated with burials, have ranged from the site being a secondary trade center to a regional base of elite power (Cameron and Toll 2001; Renfrew 2001). It is now believed that the people who built and used the buildings at Chaco were a chiefdom-like society that utilized a corporate political strategy (Earle 2001). Chaco is conceived as a place of "ideational and devotional significance," a Location of High Devotional Expression (LHDE). Prestige goods, like turquoise and shell, were exchanged in noncentralized, interpersonal reciprocal networks.

Elite status is often inferred when finely made goods or objects made of exotic materials are recovered in archaeological contexts, especially in burials. In specific locales or communities there may be several economies or spheres of interaction, including the daily subsistence sphere, an exchange economy between individuals both within and between communities, and exchanges between individuals on macroregional and long-distance scales; the maintenance of relations over time can be indicative of local and regional status. As stated by Renfrew (2001:23), these economies can exist concommittently, are not easy to distinguish, and can exist in hierarchical and "egalitarian" societies alike. This is where symbolic and ideological aspects of cultural value come into consideration.

Others have proposed that some societies can be simultaneously communal and complex, appropriately calling them complex communal societies (McGuire and Saitta 1996). The argument goes something like this: just because some activities, like hunting, planting, fishing, and tool making, were collective it does not mean that "power differentials" did not exist. Just because property could be communally owned does not necessarily mean that everyone, or every group, had equal access or properties of the same size (McGuire and Saitta 1996:201). Knowledge, whether of ritual, ideology, healing measures, crafting goods, or navigation, can be distributed unevenly, with political and economic realities that depend on parameters of specific histories and environmental settings.

Today it is recognized that all societies have some sort of status ranking, whether achieved or ascribed. Assigning societies to categories of "egalitarian" vs. "nonegalitarian," though useful as heuristic devices, does little in the way of describing the lives of past peoples and understanding process of how and why social organizational structures change over time. The debate in terminology — middle range, intermediate, autonomous, transegalitarian, complex communal societies, chieftaincies, etc. — obfuscates the issue at heart: that definitions of what is "egalitarian" and "complex" need to be reevaluated.

Other problems center on assumptions surrounding archaeological conceptions of "complexity." Typically associated with unidirectional and cultural evolutionary models, complexity is viewed by many archaeologists as necessarily linked with both economic specialization and socio-political hierarchies (and control). Power and control is hierarchical in that "higher levels affect lower levels" (Brumfiel 1995:125). As noted by Hoopes (2005), caution should be used when equating the emergence of social complexity with the development of chiefdom societies, especially when considering the classic elements or traits of a chiefdom, namely, a chief whose power is hereditary, is evidenced by individualized exhibits of wealth and prestige, and maintains the centralized control of two or more communities. Hoopes (2005:6) associates complexity with "the appearance of supravillage institutions and individuals of differential status."

Others prefer the concept of heterarchy to study the interconnectedness of socio-political and economic changes through history, practice, and context, where there is no assumption of unilineal social evolution from "simple" to chiefdom to state (Brumfiel 1995; Crumley 1979:144; 1995; Rautman 1998; Rogers 1995; Roosevelt 2004; Sassaman 2004:232; Small 1995). Instead, the various elements or components of a system are related, are interconnected, and have the potential to be unranked or ranked in a variety of ways. As discussed by Crumley (1995:3), "forms of order exist that are not exclusively hierarchical and that interactive elements in complex systems need not be permanently ranked relative to one another." Assumptions that equate complexity with stability and hierarchy have given way to an understanding of the cyclical and fluid nature of many political forms, especially tribes and chiefdoms, going back-and-forth between periods of coalescence and disintegration, with relations of power and rank reconfiguring and changing (Paynter 1989:375; Rogers 1995:8). In this way, heterarchy is not itself a specific form of social structure and organization and does not exist on the "egalitarian-complex" continuum. In fact, elements may occupy different ranks in different systems, and two or more discrete hierarchies may coexist in a system "that interact as equals" (Brumfiel 1995:25).

Recently, there has been a call to return to the study of House societies as defined by Lévi-Strauss (1982), as opposed to the blanket "application of notions of kin-group descent" in regards to kinship organization. In short, House societies are defined as

> a corporate body (moral person) holding an estate made up of material and immaterial wealth, which perpetuates itself through the transmission of its name, its goods, and its title down a real or imaginary line, considered legitimate as long as this continuity can express itself in the language of kinship or affinity, and, most often, of both
>
> [Lévi-Strauss 1982:174]

Initially described for Northwest Pacific peoples (Kwakiutl and Yurok) by Boas and Kroeber, House societies are found in a variety of social forms, but are typically described for those groups that demonstrate tribal or middle-range forms of organization and interaction; these include inequality and ranking without centralized authority, sedentary or semi-sedentary residence, conduct local and long-distance interaction and exchange and/or trade, have craft production and some degree of specialization for prestige and sacred goods, and regard ritual with high social importance. Socio-political forms vary along a continuum from more "egalitarian" to more fluid forms of social ranking to the hierarchical, where House ideology is controlled by high-status groups or elites that may, in turn, transform to centralized forms of hierarchy. Those groups with more hierarchical forms of organization tend to resemble conical clans, and the entire village is conceived as a House (Heckenberger 2005:287). House societies account for the variability and adaptability often present in descent ideology, through fictive kinships (Allen 1984; Gillespie 2000a, 2000b); kinship is also regarded as unfixed.

There is a lot of variation regarding forms of kinship among House societies. Lévi-Strauss' original contention that '*sociétés à maison*' are associated with cognatic kinship systems has been expanded by Carsten and Hugh Jones (1995:18) to include alliances, descent, and lineage-based systems. These authors hold that House society can be used as a heuristic device to better understand emic concepts of group and self identification and relations with others (Hugh-Jones 1995:251).

In House societies, the House itself, its' layout, and the layout of the village is the central symbolic representation of social order, cosmology and group identity. The House and village architecture and layout are representative of both material and immaterial "wealth," in that the architecture and layout are symbolic of the cosmological ordering of the world (Gillespie 2000a:2; González-Ruibal 2005). The House is a symbol of historic ties to community founders and cultural heroes, based on shared ideologies of a "legendary, primordial past" (Gillespie 2000a:12). Houses often lay claim to the places of origin for mythic heroes and warriors, and elites from these Houses control symbol and ritual. Plazas are viewed as the center of community, political, and ritual life, and often the locales for cemeteries, where the ancestors lie and provide legitimacy of power to the high ranking Houses. The House itself is conceived as a living organism, with its own life history: they are born, they grow, and they die (Carsten and Hugh Jones 1995:42; Ingold 2000:186). In lowland Amazonia, these forms of organization are widespread and serve as the basis for village organization, rank, and interaction; this will be discussed in greater detail in the following chapters.

Tribal (and House) societies are neither homogenous nor static, but change over time in order to remain distinct; they are flexible (Campbell 2001:540). Members of tribal groups do not necessarily all speak the same language, marry only amongst themselves, and maintain homogeneity in both tradition and material culture. They do, however, share a common heritage, whether real or fictive, a genealogical continuity, political continuity, and shared associations with specific physical places and cultural traditions. These societies can be multilingual and multicultural "agglomerates," that change over time based on self-definition, histories, local ecologies and environments. (Campbell 2001:541). Through processes of ethnogenesis, societies transform their ethnic identities, both quantitatively and qualitatively.

MODELS OF ORGANIZATION AND CHANGE

I have discussed many of the traditional traits associated with tribal societies — leadership, exchange and economics, and production — that are typically viewed as indicators of forms of sociopolitical organization. There are many models attempt to explain the development of social complexity and the transition from social and economic autonomy to centralization. The majority of these models fall into the two basic camps already discussed, environmentally deterministic (adaptationist) and socio-political economy, or, that change occurs as the result of external or internal influences, respectively (Brumfiel and Earle 1987; Curet 1992). These include such causes as environmental circumscription, population pressure, warfare, and the creation and management of surplus (Binford 1980; Braun and Plog 1982; Carneiro 1970, 1974, 2002; Cowgill 1975; Creamer and Haas 1985; Peebles and Kus 1977; Sahlins 1958, 1968, 1972; Service 1971; Steponaitis 1978; Steward 1948). As these arguments have been fully summarized and discussed numerous times by many other people, I will not "reinvent the wheel" here (Curet 1992; Siegel 1992). A "middle ground" between these opposing views is often overlooked. Individuals and their communities do not live and act in an environmental vacuum, nor are all societal decisions determined by their physical surroundings. In general, though, environmentally based theories assume that individuals make rational choices by weighing a variety of costs and benefits, and do not account for internal structural changes, innovations, and decisions or choices based in a variety of beliefs, faiths, and practices. Therefore, theories that include an heterarchical framework and approach, as discussed above, are presented in the following section. These are theories that explain emergence, change, and interaction in social systems.

Systems Theory

General Systems Theory holds that all entities behave as systems comprised of several subsystems that are governed by rules; changes in the subsystems, and their rules, can be measured and their affect in other subsystems can also be measured. A number of approaches have developed over the years that utilize a systems approach, including network and graph theory, game theory, cybernetics, and information theory (Bertalanffy 1972:416).

With origins in the British social anthropology school within the structural-fuctionalist paradigm of Radcliffe-Brown, Malinowski, and Durkheim, where the goal was to understand social relations, societies were defined as being "comprised of integrated systems, with interrelated institutions" (Trigger 1989:245). Change in one part of the system would result in changes in the other parts. While emphasis was originally on system stability, the focus turned toward the identification and description of change following World War II, influenced by the growing field of cybernetics. Systems Theory developed as a reaction against the culture-historical paradigm, which explained all socio-cultural change as the result of migration and diffusion, and the influence of external, not internal, forces and processes. Systems Theory was a theory of open systems, as first described by von Bertalanffy in the 1930s (Bertalanffy 1972:411).

The system has been defined as a grouping of a variety of interacting elements that, as a whole, can be regarded as a single large unit (Doran 1970:290). The subsystems that comprise the system are related and linked to each other, and behavior in one subsystem can be understood through these links and relations to other subsystems (Hodder 1992:25). As described by Bertalanffy (1972:411), "in order to understand an organized whole we must know both the parts and the relations between them." External impacts or interventions can have only temporary effects on the system. Systems Theory does not explain how change occurs, though, it describes change.

Wallerstein's World Systems Theory of an emergent global economy has been adopted by many archaeologists (at least heuristically) since its inception in the 1970s, in reaction to evolutionary sociological theories of development. That is, once societies start down the road to modernization (or acculturate to the dominant/superstrate society), they must continue down a sequential path of stages of development. Wallerstein (1974) contended that there exist only two true forms of social systems: autonomous foragers (world economies, with no common political system) and agricultural societies (world empires, with common political systems). As empires expanded, they incorporated these "minisystems" into their own growing system, whether political or economic. Cores developed that were centers of manufacture, technological innovation, skilled labor, and cultural innovation. Cores were supported by an expanding periphery, which supplied material resources and unskilled labor in order to generate surplus for the core; the peripheries had no economic or political power. Changes in the system are caused by economic and political concerns of the core that spread throughout the system, with little influence or input from the hinterlands. Semi-peripheries exist between these two ends that act to absorb unrest and anger of the periphery while receiving economic benefits from the core.

Many archaeological studies that embraced World Systems Theory concentrated on the relations of the core with the "other." Until recently, interaction and social change on the frontier itself has not been the subject of inquiry. Archaeologists have modified World Systems Theory to better fit non-Western, non-capitalist contexts. While Wallerstein had many wrong assumptions regarding prehistory and the organization of non-Western societies, some of these tenets — namely, that societies should not be studied or viewed as isolated entities but as interacting systems comprised of many dynamic components — hold true.

Network and Social Exchange Theories

As stated above, systems theory has spawned numerous "daughter" theories, including those of network and social exchange. Network theory is empirical, and holds that patterns of interaction between actors can be graphed. It is assumed that the structure of the society is comprised of patterns of ties between actors, and variation throughout the network is based on the strength of these meaningful ties (Cook and Whitmeyer 1992:114-118). Network theory seeks to understand how societies are structured internally through the interactions and networks that connect individuals (communities, etc.) to each other, or, how the system's structure impacts and influences individual interaction.

Social exchange theory, on the other hand, views all social interactions as series of exchanges of valued items between actors, whether tangible or intangible. The actor is driven or motivated by rewards and self interest, and is therefore assumed to be a rational being who weighs, whether consciously or unconsciously, the costs and benefits of the exchange. This leads to the development of power relationships between the actors (Zafirovsky 2005:1). Changes at the level of the individual have repercussions throughout the larger system. Unlike microeconomics and behaviorism, from which this theory borrows heavily, the focus is on the life cycle of long-term social relations — their creation, maintenance, and eventual death — and the factors that influence them over time (Cook 2000:687). Social exchange theory, however, typically does not account for symbolic social exchanges, and does not account for cultural contexts or cross-cultural variation (Cook 2000:688; Zafirovsky 2005:12).

What these two theories have in common is the central role of the actor, or agent. While the actor can be motivated by rewards and benefits they do not explain all patterns of interaction. The structure of the system in which the actor exists does shape and influence the actor's choices, which in turn reverberate through the system (Figure 2).

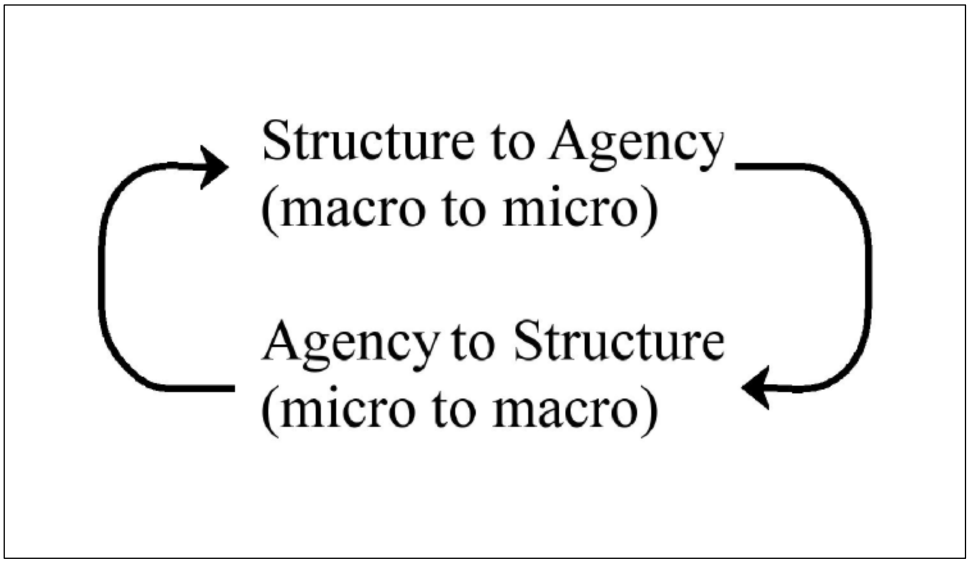


Figure 2. Model of system and individual social interaction.

Practice Theory

Theories of Practice developed as a reaction to this disregard of these intangibles, especially regarding the influence the individual can have on a social system, and the origins of these theories can be traced to earlier works in symbolic anthropology by Clifford Geertz and Victor Turner, based largely in schools of systems and process (Ortner 1984; Vincent 1986). Geertz (1973) called for the study of symbols (public symbols) as ways of understanding how communities and societies communicated their identity, worldview, ethos, and values and beliefs to the world. He also called for studies to be conducted from the emic perspective. Turner (1967) took the study of symbols further, contending that symbols are not only representative of but active forces in social processes by reinforcing meaning.

Practice Theory, as known today, has been based largely on the works of Anthony Giddens' (1979) ideas of structuration and Pierre Bourdieu's (1977) concepts of *doxa* and *habitus*. The theory (or group of various theories and ideas) maintains that the activities and routines of daily life, such as growing, preparing and serving food, making cooking vessels, building houses, etc., result in the creation and maintenance of patterns of behavior; in other words, "the generation of structures in social action" (Hodder 1996:105). The materials that are created as a result of these behaviors, over time, are physically deposited on the landscape. The archaeological study of these patterns can reveal a community's conceptions of spatial organization, and their definitions of

Self and "Otherness." These theories seek to explain the "genesis, reproduction, and change of form and meaning of a given social/cultural whole" (Ortner 1984:149).

The system (society, culture) shapes practice with socially-defined rules (what is good, bad, edible, etc.). The system, in turn, reproduces and changes through practice, and is reinforced via the use of symbols in both ritual and through daily activities of life. Ortner (1984:148) defines the system as "patterns of relations between categories, and of relations between relations," and is conceived as sets of relations — political, economic, values, and social rules — in which none take priority over the others. Societies and communities impact and are impacted by their surroundings, both natural and cultural. Societies undergo organizational change as part of processes of adaptation and adjustment to environment, history, learned strategies and habits, ever-evolving belief systems.

Agency Theory has developed out of practice and complexity models, with the primary emphasis focused on the assumed rational actions of the individual to demonstrate power. These interactions between agents on the individual level are regarded as greatest influences and factors in broader cultural arena; however, individuals cannot be viewed as independent of the social system in which they exist, of their structuration (Layton 2003:103). Agents/actors do not act completely rationally, but make decisions and act within the strategies that have been learned.

Complexity Theory, Complex Adaptive Systems, and Small-Worlds

To quote Bentley and Maschner (2003:1), "Complexity theory…is not a theory so much as an approach to systems that cannot be explained by reduction to their component parts." While systems theorists view human society as closed systems that strive to achieve stable states, complexity science sees society as open systems incapable of maintaining equilibrium. Complexity incorporates the notion that changes in all evolving systems are based on a multiplicity of causes rather than a single cause or prime mover. All agents, whether as individuals, groups, villages, or even larger regional networks, are interconnected so that changes in one arena affect others.

Complexity, in this context, is defined as "the capacity of nonlinear interactions within clusters of activities and processes (both social and natural) to generate emergent structuring through self-organization" (McGlade 2003:115). In contrast to systems theory, practice and complexity theories view systems, whether societies or the environment, as open and dynamic.

A complex adaptive system (CAS) is defined as

> …the study of systems built of individual agents that are capable of adapting as they interact with each other and with an environment, and especially the attempt to understand how the characteristics of individuals affect the system-level responses.
>
> [Railsback 2001:49]

Levin (1998:432) identifies three essential elements of a CAS: 1) the diversity and individuality of components is maintained, 2) interactions between the components are localized, and 3) subsets of the components are selected for reproduction and alteration based on these local interactions through autonomous processes. Hierarchy emerges as a result of selective processes.

CAS are dynamic, they self-organize, they are nonlinear, they maintain diversity, and they coevolve to the "edge of chaos." Self-organization is a property of CAS in which patterns observed on smaller scales are replicated at larger scales throughout the system. CAS are nested hierarchies that can contain other CAS (Anderson 1999). The interaction network patterns that develop in a CAS self-organize hierarchically by power-law distributions, in that a few key agents within the network are well connected, while the majority of agents are loosely connected to each other through these key agents (nodes). A network that is comprised of nodes that are connected to each other via roughly the same number of links is said to be more egalitarian and random than those networks where a few nodes or hubs control numerous links between nodes that are not as well connected; these are described by Buchanan (2002:119) as "aristocratic" (Figure 3).

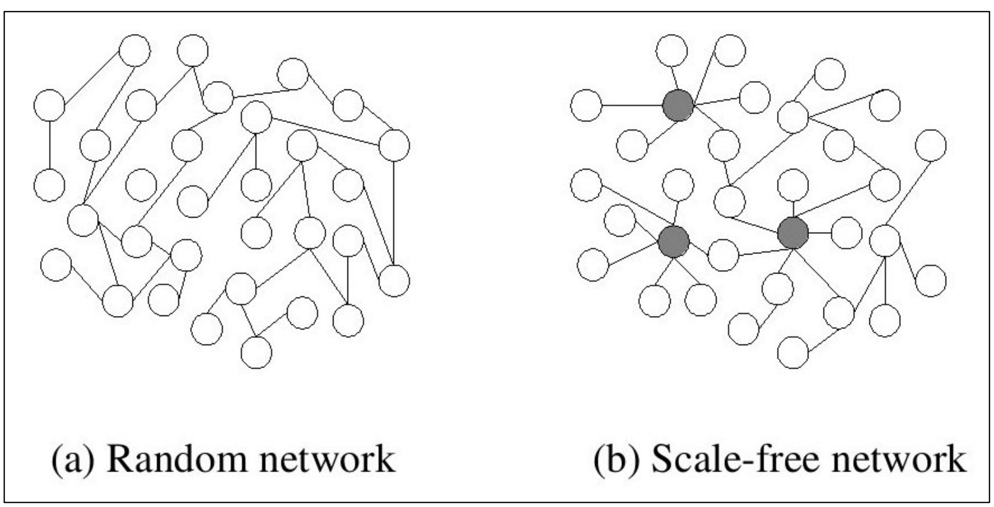


Figure 3. Illustration of random and a scale-free small-world network. Adapted from Castillo 2004:14 (Figure 2.1).

The presence of scale-free networks through power law distributions are a key component of CAS (Bentley 2003:17; Bentley and Maschner 2001:41). In short, a power law distribution means that changes occur on all scales, no matter how small or large; in other words, power law distributions demonstrate scale invariance. These distributions are unique in that, when graphed, they do not illustrate a natural distribution or bell-curve, nor do they cluster toward an average. Instead, there is an exponential decrease from an upper limit. Finally, scale-free networks are vulnerable to collapse if just a few, well-connected nodes are removed from the system; the removal of several nodes that are only minimally connected to the system will not cause the network to collapse (Barabási and Albert 1999; Wang and Chen 2003:14-15).

Power laws exist in archaeological contexts, especially in regards to rank-size distributions of settlements. In short, it is assumed that the most important settlements (or archaeological sites) have the largest populations, and thus are physically larger and fewer in number than the majority of settlements that are smaller in both physical and population size. Rank-size distributions for settlements have been well demonstrated both in archaeology (for ancient and historical regions) and geography (in modern society; Bentley 2003:15; Haggett 1983; Maschner and Bentley 2003:49).

CAS models integrate the traits, properties and interactions of individuals (agents) into explanations of how these interactions result in the emergence or development of system-wide patterns of organization and adaptation. These patterns (interactions) continually develop and change, and new components are constantly introduced to the system (Anderson 1999; Lansing 2003; Levin 2002, 1998). Over time, as these various components and agents within a system interact, change, and adapt a “tipping point” is reached that is commonly referred to as the “edge of chaos.” The process is analogous to a pile of rice or sand; as more rice is added, small avalanches occur that act to stabilize the whole. At a certain point, a threshold is crossed and the pile collapses, with changes sweeping throughout the entire system (Bentley and Maschner 2003:67). Both social and natural systems are constantly emerging from a variety of sources. In some circumstances, structures may appear to be stable on the surface, but over time can be drastically altered by seemingly minor influences. This process is coevolutionary in that the change is controlled by interdependencies and selections between agents, resulting in self-organization.

Patterns of networks in CAS, such as small world networks, illustrate how unequal and hierarchical social relationships are maintained (Bentley 2003:27). A small world network, commonly known as "six degrees of separation," is one in which people living in small communities are connected with other people in neighboring communities throughout a larger network via a small number of links connecting communities to nodes or hubs (Bentley and Maschner 2003:69) (see Figure 3). The interactions between agents in the system determine "the preferential growth of measurable properties" which favors some agents over others (Bentley and Maschner 2001:36). In other words, the majority of agents are poorly or loosely connected to each other along short paths, while a few rise as well-connected hubs. Small-worlds are highly clustered, and can be common in sparse networks consisting of many nodes. While closer neighbors may interact more frequently through short but weak connections, the well-connected hubs will be joined to each other via longer and stronger but more infrequent links that hold the entire system together. These connections, when graphed on a histogram, also demonstrate power-law distributions of agent attributes. Bentley notes (2003:39) that the social networks that exist among communities and societies are an integral part of how wealth, power, prestige, and status is communicated and transmitted. Prestige and status for a particular community can grow as a leader's ability to develop and expand long-distance exchange and social networks.

Regarding the distribution of archaeological materials, well-connected nodes (or sites) will have artifacts indicative of long-distance connections to other well-connected nodes. These nodes may also be locations of specialized production and/or distribution, in that their location on the landscape may not necessarily be physically central to the other nodes within the small world. They may actually be located between interaction spheres, on frontiers, or on borders between two developing small-worlds.

SUMMARY

Throughout this discussion two common themes have emerged. First, middle-range, tribal, and/or House societies are flexible and opportunistic. These societies will settle in new areas similar in many respects to their homelands, and will do their best to continue their lifeways and belief systems. They will also make efforts to maintain ties with each other, with the homeland, and possibly with any new peoples they encounter. Systems of exchange and specialized production, and forms of socio-political organization will vary according to the local resources available, the histories of each group, and the continued reinforcement of *habitus* through practice while, at the same time, integrating new experiences and strategies. Like ecosystems, human societies are complex and adaptive, where macroscopic patterns (like structure and interaction) emerge and develop as a result of interactions at the level of the individual; these interactions are linked to other components in a system via feedback loops (Abel 1998; Anderson 1999; Lansing 2003; Levin 1998, 2002; Railsback 2001).

Societies are organized in a variety of forms of integration and development, (Blanton et al. 1996; Costin 2000; Crumley 1995; Rautman 1998; Steponaitis 1978). Established categories of "tribe" and "chiefdom" do not account for the variability in social organization dependent upon unique sets of circumstance, location, and history, and evidenced by more recent research on subsistence and settlement patterns and processes of culture change. Likewise, social inequality is present in nearly all political forms, and is based not only on the classic definition of control of wealth and status by a few. Inequality includes the management and control of transportation of prestige and sacred goods, skills in creating prestige and sacred objects that demonstrates control of the supernatural, control of ritual spiritual knowledge, and knowledge of the foreign and distant. Many theories of socio-organizational change in tribal societies are centered on conceptions of adaptive responses to external stimuli, otherwise staying in a hypothetical state of equilibrium. It is now understood, however, that there are a variety of causes and influences, both internally generated and externally reactive, for broad societal changes. In this way, conceptualizing Saladoid tribes as heterarchies may be a more productive approach for understanding societies that appear to be both "complex" yet noncentralized and nonhierarchically organized.

The emphasis of the majority of this chapter has been on economy, craft and prestige good production, and exchange and distribution. This does not mean that economy and modes of production are viewed as the sole catalyst for changes in societal organization, or for increasing institutional inequality. Rather, these are topics that have been little discussed in relation to Saladoid period societies but are well developed for other archaeological regions around the world. Local, regional, and macroregional systems (or spheres) of interaction, exchange and communication can be hypothesized and mapped based on the present knowledge of community location and size. These spheres will contain evidence of change in worldview and beliefs as realized in tangible goods (artifacts), and can potentially demonstrate how variation in the qualities, styles, and composition of material goods are indicative of broader changes across the entire system.

In the next chapter, I step away from this theoretical discussion and provide the environmental and cultural background to the island societies of the Caribbean, and St. Croix in particular.

CHAPTER 3

BACKGROUND: ISLAND WORLDS

St. Croix and the other U.S. Virgin Islands form part of a chain of islands known as the West Indies that, beginning with Cuba, extend southeastward in a broad arc, ending with the Island of Margarita near the mouth of the Orinoco River, Venezuela (see Figure 1). This chain of islands has been subdivided into the Greater Antilles — the four largest islands of Cuba, Hispaniola, Jamaica and Puerto Rico — and the Lesser Antilles, comprised by the remaining smaller islands and cays. In most respects the U.S. Virgin Islands are more similar to the islands of the Greater Antilles, including geological and environmental conditions (Henderson 1999; Rouse 1964; U.S. Department of Agriculture 1998:15).

This chapter discusses those resources that would have been available to prehistoric settlers of the Caribbean who developed into the variety of cultures encountered by Columbus and later colonists. It is divided into two main sections – environmental settings and culture-historical background – that are comprehensive in scope. A detailed description of St. Croix's archaeological resources and cultural heritage is provided in Chapter 4. I also present the arguments for social organization in lowland South America during the Saladoid period, and use ethnographic studies as analogies for the potential of status differentiation among the "tribal" Saladoid. In the end, I propose that the Island Saladoid explorers and settlers were a part of a larger Arawakan interaction sphere which incorporated what has been alluded or referred to by some as the Arawakan Ethos (Boomert 2000a; Heckenberger 2002; Hill 1996; Hornborg 2005; Santos-Graneo 2002). This interaction sphere expanded with an Arawakan diaspora that occurred ca. 2500 BP, and the Saladoid cultures of the Caribbean represent the frontiers of this expansion. The arrival of Saladoid cultures was not the result of a single migration, but of multiple movements and arrivals of multiple groups, sharing common cores of beliefs and forms of social organization, evident in the ubiquitous presence of Red-on-White wares at their settlements. It is also possible that other peoples were arriving to the northern Antilles either just prior to or contemporaneous with these Saladoid cultures, quite possibly from Costa Rica or coastal Colombia.

From the outset, I state that this research is not a criticism of the pioneering work of Irving Rouse. Rather, with newer information that has been gathered over the last several decades, improvements in radiometric dating techniques and greater numbers of dates obtained for archaeological sites, better systematic control used in archaeological investigations, and better ethnographic understandings of the complexities and variabilities in the organization and interactions of tribal or middle-range societies, it is time for a reevaluation of his original findings. Good theories are refined and improved over time, and it is not necessarily always better to through out the old just because newer data may encourage new interpretations of the past.

ST. CROIX ENVIRONMENTAL SETTINGS

Climate, Physiography and Geology

St. Croix is located roughly 40 miles south of St. Thomas and St. John, and about 60 miles east-southeast of Puerto Rico (Figure 4). The island is the largest of the Virgin Islands, measuring nearly 20 miles long and about five miles wide, covering approximately 82 square miles (21,237.9 hectares). It is the topographic high of a single landmass; it sits on the southern edge of the Greater Antillean Ridge (U.S. Department of Agriculture 1998:18). For this reason, it is geologically more similar to the islands of the Greater Antilles than the Lesser Antilles. The island is separated from Puerto Rico and the northern U.S. Virgin Islands of St. Johns and St. Thomas by the Virgin Islands Basin, which is 4,500 meters deep (Gill et al. 1989:49).

The island has a dry subtropical climate. Average rainfalls on the island are extremely variable, ranging from 40 inches (102 cm) in the western portion to 30 inches (76 cm) in the east, 50 inches in the northwest and 25-35 inches in the southwest (U.S. Department of Agriculture 1998:13); these amounts are low compared to Puerto Rico and Hispaniola primarily because of the lower elevation and the removal of the majority of forests during the colonial era. The relative humidity averages about 70 percent, and average high daily temperatures are 88°F (31.11°C) in August and 80°F (26.67°C) in December. Tradewinds blow primarily from the east or east-southeast through most of the year, with speeds occasionally exceeding 20 knots from June through August. From December through February, however, tradewinds blow from the east and northeast with an occasional blast from the north commonly called the “Christmas Winds,” which lasts from one to three days and is accompanied by rains and low maritime visibility (NPS 1990:54-58). Waters are at their calmest from April through August, and winds are typically weaker from March through May and August through November. It is estimated that hurricane force winds hit the Virgin Islands once every 16 years. Since 1867, over 36 hurricanes and 14 tropical storms have hit the island (U.S. Department of Agriculture 1998:13).

There are two primary seasons — wet and dry — that are further divided into short and long wet and dry periods, the long dry season being typically between January and March or April, and a second, shorter dry season in June and July. Throughout the Greater Antilles, the northern halves of the islands (windward side) are typically much wetter than the southern, leeward sides.

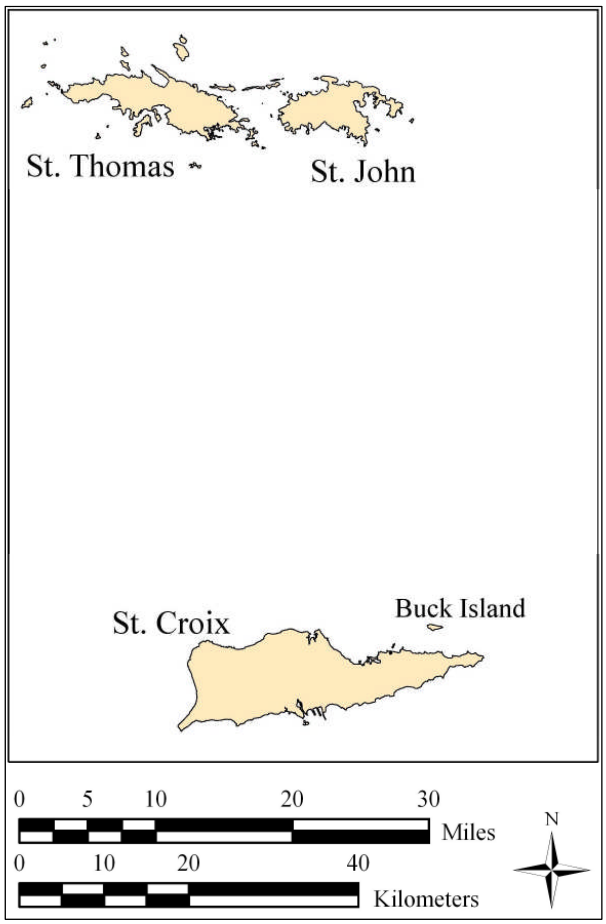


Figure 4. Map of St. Croix and proximity to other Virgin Islands.

Soil, lake, and marine cores taken from Haiti and on Puerto Rico demonstrate, however, that these conditions are not stable. Over the last 10,000 years, climate in the Greater Antilles-northern Lesser Antilles has vacillated between dry and wet conditions (Siegel et al. 2005:90; Nyberg et al. 2001), based on changes in evaporation and precipitation rates as evident in the pollen record. By roughly 7,000 BP, forests were expanding as the region became wetter and warmer, and these conditions continued until roughly 3,200 BP, when climatic drying began

(Hodell et al. 1991). The regions' response to climate change is similar to that found on the continental, lowland circum-Caribbean area. Ice cores taken from the Quelccaya ice cap in southern Peru found that there were three dry periods that occurred throughout tropical South America, A.D. 1720 – 1860, A.D. 1250 – 1310, and A.D. 570 – 610 (Thompson et al. 1985). Oxygen isotopes and pollen data from sediment cores taken from Lake Miragoane, Haiti, confirmed these findings, with a dry period lasting from roughly 500 B.C. to 500 A.D., and a wet period from ca. A.D. 450 to A.D. 1000 (Hodell et al. 1991:792). These cycles of wet and dry periods were then correlated with short climate events.

St. Croix consists of three primary physiographic regions: two mountainous areas in the northeast and northwest portions of the island, and a coastal plain in the south (Figure 5) (Cederstrom 1950; U.S. Department of Agriculture 1998). The two predominant mountain ranges, the East End Range and the Northside Range, are separated by a sediment filled graben structure, typically referred to as the Kingshill Basin (Renken 2002b:131). This central valley was actually, during the Cretaceous to the Tertiary periods, a channel that separated two independent islands. As lands were uplifted and sediments eroded the channel gradually filled, first becoming a lagoon surrounded by a coral reef, then the alluvial fan-covered valley. These wide fans have, over time, continued to bury the marine sediments from Christiansted to the southwest, while recent marine terraces have been exposed in coastal areas and in the south-central and southwestern regions of the island. The mountains have been cut by streams or water flowing down guts, resulting in steep slopes and valleys. On the western end of the island there is an intrusion of gabbro into younger igneous folds (Cederstrom 1950; Whetten 1966). The west end of St. Croix, near Ham's Bluff, is known for containing well developed quartz veins. Intrusions of diorite stretch in a band that runs southeast from Christiansted to Great Pond.

Underneath the central valley lies the Jealousy Formation (dating to the Oligocene or Miocene age), a planktonic and foraminifera-rich carbonate limestone that is often called "Blue Clay" for its dark grey-blue coloring (Figure 6). The Jealousy Formation is overlain by Kingshill Limestone, which is further divided into the La Reine and Mannings Bay Members. Both of these formations have similar mineralogy, comprised of planktonic foraminiferal carbonate mud and marl, but the Kingshill Limestone is light buff in color (Gill et al. 2002). Above these formations is the Blessing Formation, a reef and shelf limestone.

Underneath the Northside and East End Ranges lie the oldest exposed rocks on St. Croix, composed of sedimentary deposits that date to the end of the Cretaceous period (roughly 90-100 million years ago). Added to these deposits were rocks of magmatic origin that formed during the mountain building episodes, prior to the collision of the North American and Caribbean plates.

The substrates are composed of faulted and deformed volcaniclastic and sedimentary rocks of the Mount Eagle Group, which have been intruded by Southgate Diorite (Speed 1989:9; Speed and Joyce 1989:23; Olcott 1999; Nagle and Hubbard 1989). The Caledonia Formation, the base sedimentary unit, is primarily composed of mudstones, sandstones, limestones, cherts, and conglomerates. Deposits within the Mount Eagle Volcanics Group include tuffaceous sandstones, marine limestones, breccias, and deep water volcaniclastics (Gill et al. 2002). Quaternary alluvial deposits consisting of unconsolidated materials derived from the sedimentary and volcanistic formations are found in deposits along stream margins, and on beaches that surround bays. The alluvium is typically composed of clay and silt, with some lenses and interbedding of sand and gravel. Clays are largely confined to deep guts.

The mountainous and steep slope areas are exposed to consistently warm temperatures and seasonal cycles of wet winter/ dry summer, resulting in the development of soils that can vary greatly in type within a short distance (Foth and Schafer 1980:27-29). Soils of the Greater Antilles and the Virgin Islands are typically classified as Inceptisols, Ustalfs (and Haplustalfs; Alfisols), Vertisols, or Mollisols. Inceptisols are soils of humid regions that contain weatherable minerals, and are poor to well drained (Tropepts are Inceptisols of tropical or subtropical areas) (U.S. Department of Agriculture 2002; http://soils.usda.gov/classification/taxonomy/tax.pdf). Alfisols consist of argillic horizons (clays), with considerable amounts of water available for plants, and medium to high base saturation (35 percent or more). Ustalfs are the Alfisols of warm semiarid and subhumid areas, with a ustic soil moisture regime and thermic or hyperthermic temperature regime (Foth and Schafer 1980:168). Because of annual dry seasons the natural vegetation that arises on Ustalf (and Haplustalfs) soils are typically deciduous or xerophytic. Vertisols are clayey soils that dry out and crack at some point during the year. These soils may be of Typic, Udic, or Xeric (typical, humid, or dry) moisture regimes. Mollisols develop in areas with some degree of yearly drought, and are the soils of grasslands and savannahs (Foth and Schafer 1980:111). In addition, the Mollisol suborders of Aquolls and Ustolls (as well as two of the Ustoll great groups: Haplustolls, Argiustolls) are found throughout the Greater Antilles, where they generally appear as grassland areas. Aquolls are wet Mollisols, typically composed of black and gray-colored soils, and contain a high amount of organic matter (Foth and Schafer 1980:114). Ustolls have ustic soils moisture regimes (between arid and humid).

The United States Department of Agriculture-Soil Survey Laboratory of the National Soil Survey Center has classified the soils of St. Croix into a number of series (Figure 7) (U.S. Department of Agriculture 1998). These soils appear as a patchwork or mosaic, depending on slope, elevation, permeability, and other factors.

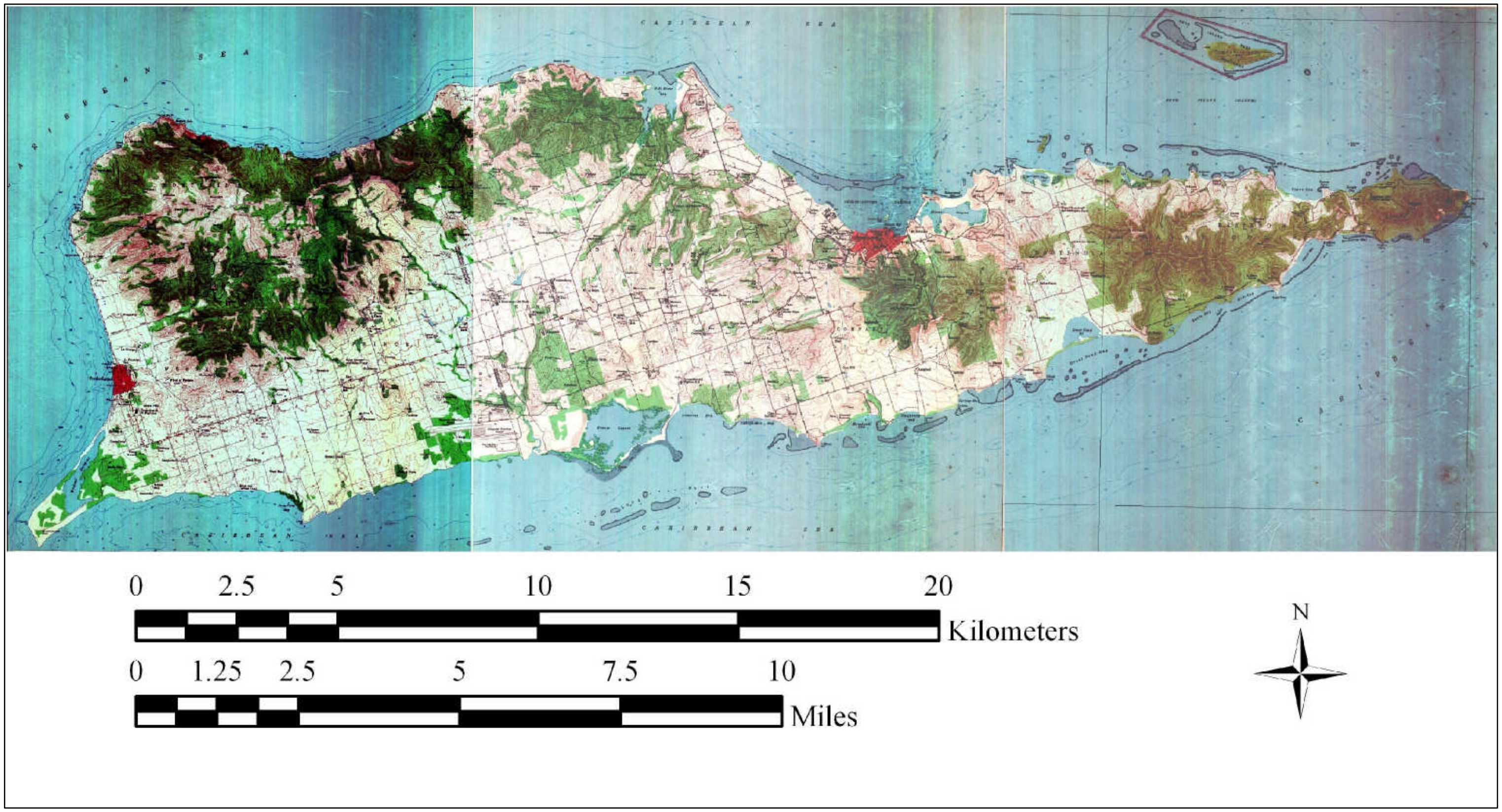


Figure 5. Generalized physiographic map of St. Croix. 1958 USGS Topographic Map.

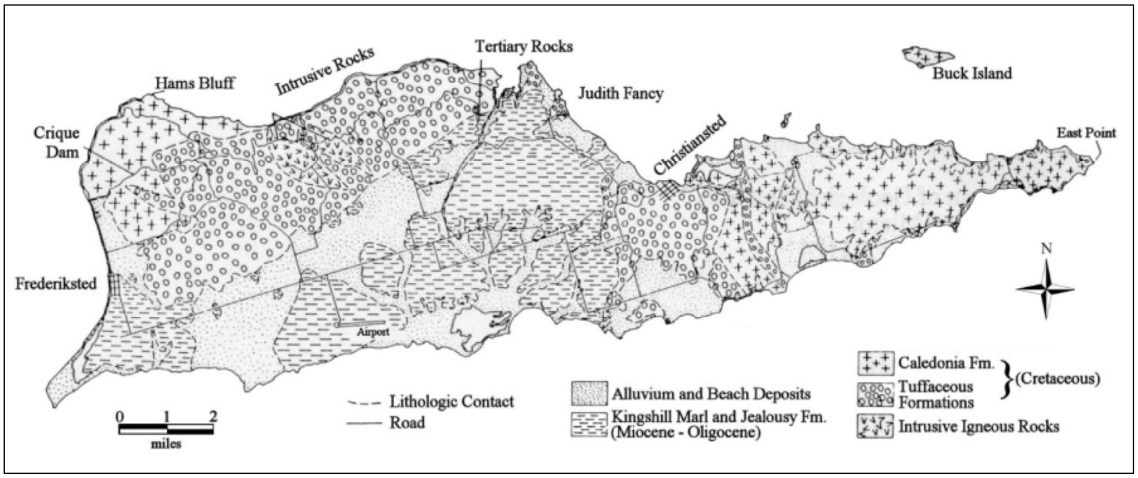


Figure 6. General geologic map of St. Croix. Adapted from Nagle and Hubbard 1989:2; Whetten 1966.

The majority of soil types for the Northside Range include the Annaberg-Cramer-Southgate series, while the rest of the northern portions of the island are dominated by the Southgate-Victory-Cramer series. These soils are all gravelly loams and gravelly sandy loams, and are generally not well suited for crop production. On the other hand, the soils of the alluvial fans and terraces of the central Kingshill Basin are well-drained, clayey loams to gravelly loams and are well-suited for crop production. These soils are comprised of the Glynn-Hogensborg series for the upper elevations and the Hesselberg-Sion-Arawak series for the lower elevations to the sea. As will be further discussed in Chapter 4, many of the early Saladoid period villages were located on these Glynn-Hogensborg and Hesselberg-Sion-Arawak soils, while later Saladoid and early Ostionoid-period villages were located on Annaberg-Cramer-Southgate and Southgate-Victory-Cramer soils. Finally, the soils found at salt ponds and tidal areas are typically thick organic mucks and mucky clayey loams, such as the Sugar Beach and Sandy Point series.

Glynn series soils are found along drainages and alluvial fans and terraces. They are well-drained and deep, and are slightly alkaline to strongly alkaline. Annaberg-Cramer series soils, on the other hand, are shallow and well-drained, are found on the summits and slopes of volcanic hills and mountains, and are slightly to strongly acid. Victory-Southgate series soils are also found on the tops and slopes of volcanic hills, but are deep and slightly acid.

There are two soil series — Hesselberg and Arawak — that are alkaline and contain calcium carbonate nodules and concretions. Both of these series are shallow and well-drained; Hesselberg soils are found on marine terraces and range from slightly to strongly effervescent, while Arawak soils are found on slopes and summits, and develop as the result of weathering of limestone hills and mountains. They also range from slightly to strongly effervescent.

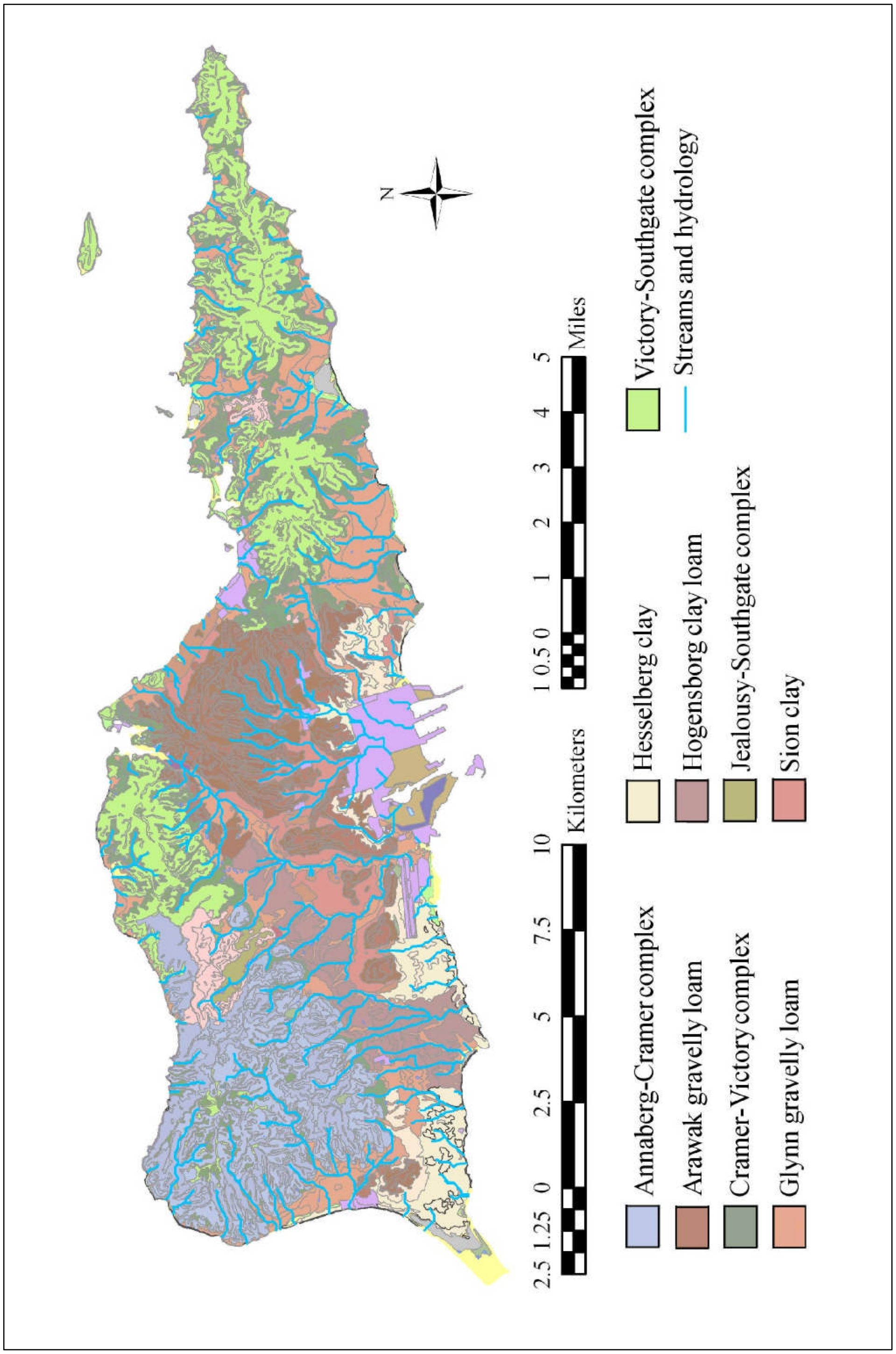


Figure 7. Map of major soil types found on St. Croix. Data from the NRCS, U.S. Geological Survey.

Hydrology and Hydrogeology

Sources of fresh water on St. Croix are scarce, which has been a matter of importance for people living on the island since their first arrival some 2000 years ago. The majority of water consumed on the island today is from catchment, primarily through cisterns. There is a freshwater aquifer located under the Kingshill Basin in the southern-central portion of the island, in the Kingshill Limestone. The Kingshill Aquifer is the only extensive sedimentary rock aquifer in the U.S. Virgin Islands (Baily 1996:137; Gill et al. 2002; Olcott 1999).

Additional aquifers on St. Croix include alluvial, fractured bedrock, and coastal embayment aquifers. Alluvial aquifers are basically temporary storage areas for rainfall and runoff while they slowly percolate down to the carbonate aquifers below (Renken 2002a:2). They exist in alluvial fans, poorly sorted debris flows in slope wash, stream alluvium, and lagoon mud deposits (Renken 2002b:125). Bedrock and fractured bedrock aquifers are basically faults and fractures in exposed bedrock that hold rainwater. They are often found in the upper 50 to 300 feet of fractured and weathered volcaniclastic, plutonic, and sedimentary rocks (Olcott 1999).

St. Croix also has four major streams that flow intermittently but in times past, as recorded by French settlers in the seventeenth century, were perennial. All of these streams or small rivers begin in the Northside Range – Creque Gut, Mint Gut, Caledonia Gut, and Salt River. Additionally, there are numerous drainages and small tributary streams that today are rain fed. Altogether, there are seven drainage systems across the island, most of them being split along an east-west axis of hilly to mountainous ridges (see Figure 39, Chapter 4).

Biotic Communities

The animal and plant communities that occupy the Virgin Islands today are the result of a series of seminal events that include climatic changes and human interventions dating back many thousands of years. Approximately 18,000 years ago, during the maximum Pleistocene glaciation, sea levels were roughly 200 feet below their present level. This was due to the large quantities of water retained by the massive ice sheets covering the North American continent (Woodbury and Little 1976:3). Due to the lower sea levels, many of the Caribbean islands were connected to each at one time or another. It does not appear, however, that any of the Caribbean islands, except possibly Cuba and Hispaniola, were ever continental in scope (connected to the mainlands of North or South America). Always isolated from the larger continental plates of North and South America, there is no evidence of large mainland fauna ever having inhabited the Greater Antilles (Rouse 1992:4). With the rising of sea levels and changing climatic conditions that followed the last several ice-ages, the number of faunal and floral species located on these isolated islands dwindled but became increasingly specialized, replicating a pattern that has also been observed on remote Pacific islands (Petersen 1997:120; Raffaelle 1989:7).

By the time of the arrival of the first known human explorers to the region nearly 6,000 years ago, warmer climates and easterly tradewinds had sculpted the Greater and Lesser Antilles into their basic present forms: islands with unique biotic communities that fostered the development of broad based foraging and maritime economies, inter-island trade networks and frequent cultural exchanges.

Coral barrier reefs are diverse ecosystems, and have complex relations with other contiguous ecosystems, such as seagrass beds. St Croix has several extensive barrier reef systems, complete with well-defined lagoons, not found on either St. Thomas or St. John. Over forty species of scleractinian corals have been recorded on the coral reefs of the Virgin Islands. These species include elkhorn coral (*Acropora palmata*), the primary reef-building coral of the entire Caribbean, star coral (*Montastrea annularis*), staghorn coral (*Acropora cervicornis*), and finger corals (*Porites* sp.)

A submarine canyon dominates the offshore environment at Salt River Bay, on the north shore of St. Croix, which is composed of a shallow pavement shelf roughly 9 to 15 meters deep that gradually drops into a deep forereef, ranging in depth from 15 to 21 m. The canyon then plummets to a depth of over 12,000 feet (roughly 3650 m) (National Park Service 1990:64). The shelf consists of scattered elkhorn, brain, fire, boulder, and staghorn corals, while the walls are dominated by lettuce leaf corals (*Agaricia* spp.), sponges, and other soft corals; the canyon floor consists of seagrasses and seaweed beds.

The open sand beaches of the island are composed of decomposed calcium carbonate skeletons from marine algae, and pieces of coral reef and shells. The sand is brought to the shore by tides, currents, and wave action. Crabs, mollusks, and other invertebrate fauna that inhabit the beaches serve as food for various shorebirds, such as sandpipers and terns. These beaches are critical nesting habitats for three species of endangered and threatened sea turtles. Plants typically found on open beaches include bay flower (*Blutaparon vermiculare*), sea purslane (*Sesuvium portulacastrum*), bay cedar (*Suriana maritima*), seagrape (*Coccoloba uvifera*), coughbrush (*Ernodea littoralis*), and bay hops (*Ipomoea pes-caprae*) (U.S. Department of Agriculture 1998:16).

Rocky coasts and offshore rock habitats typically have little vegetation due to the constant barrage of waves. These areas serve as anchors for many types of invertebrates, as well as roosts for shorebirds, gulls, and wading birds. Plants typically found on open beach areas can also be found on rocky coasts.

Mangroves are tropical to subtropical intertidal forest ecosystems, subject to saltwater tidal immersion. While they can adapt to brackish conditions, and can be found in bays that serve as freshwater watersheds, they are not solely components of freshwater ecosystems. They are often found at the mouths of streams and rivers. Mangroves are "landbuilder communities," they extend shorelines via systems of prop roots, trunks, pneumatophores, and saplings that trap and stabilize erosional terrestrial sediments (Schwadron 2002:29). It has been reported that in some fringing mangrove systems, prop roots can result in anywhere from 25 to 200 meters of coastal accretion a year (Wiley and Vilella 2002:15). In areas with high turbidity, fringe mangroves may act to slow sediment runoff and filter suspended solids. The accumulation of sediments furthers the process of deposition and shoreline extension, and elevates the land surface. Peats may also develop in low-energy environments. Because of their high organic content and calm waters, mangrove forests serve as nurseries for many species of both invertebrates and reef and marine fishes. They also provide subsistence for many species of crustaceans, wading birds, and small mammals. Mangrove forests are, therefore, extremely productive ecosystems with very high biodiversity.

Today, there are three large remaining mangrove communities on the island: at Great Pond (south shore), Atlona Lagoon (north shore), and Salt River Bay (north shore), in addition several smaller ones. The largest mangrove community in the Virgin Islands was located at Krause Lagoon but it was destroyed in the early 1960s, with the construction of a large industrial complex

The Salt River watershed is the only remaining estuarine system on St. Croix (NPS 1990:64). Fifty years ago, Salt River was a flowing freshwater stream but today runs intermittently with heavy rains. The watershed drains nearly 3,000 acres into the head of Sugar Bay. The estuary itself is a partially-enclosed body of water exposed to the ocean, a relict drowned river valley. Estuaries, on the whole, are highly productive, and like mangrove forests, provide a nutrient rich and safe environment for juvenile and larval-stage marine organisms. In the past, there were several perennial freshwater streams; on historic maps dating to the seventeenth and eighteenth centuries, two of these streams were labeled as rivers: *Riviere Sallee* (Salt River) and *Riviere du Cap* (Figure 8). These guts now only flow intermittently with heavy rainfall. The heads of most of these streams are primarily in the Northside Range, a point which will be discussed later in this research.

Saltwater ponds develop when corals grow across the mouth of an indented shoreline that is indented (Wiley and Vilella 1999; http://biology.usgs.gov/s+t/SNT/noframe/cr133.htm). As sediment and other materials are deposited on the corals, often as a result of storms, they build a landmass that traps the salt water. In high tides or storms there may be water exchange between the pond and the sea. Typical vegetation surrounding saltwater ponds include red, black, and white mangroves, buttonwood (*Conocarpus* sp.), sage, seagrape, casha (*Acacia tortuosa*), croton (*Codiaeum variegatus*), and white manjack (*Cordia alba*). The understory consists of sedges, grasses, and ground covers (NPS 1990:81). Typical animal species found here are birds who feed on invertebrates and insects, such as plovers, the Bahama white cheek pintail, and herons.

Figure 8. Lapointe (1671) map illustrating major streams or rivers. Note that north is at the bottom of image. Courtesy of the St. Croix Landmarks Society, Whim Plantation, St. Croix.

Subtropical dry forest covers much of the landmass of St. Croix, but this is a relatively recent development. Prior to the arrival of European colonists, much of the northern (windward) side of the island would have been covered in semi-evergreen rain forest, while the southern (leeward) side, receiving less rainfall, would have likely consisted of subtropical dry deciduous hardwood forests. These forests were mostly were cut down not once, but twice – in the seventeenth and again in the eighteenth centuries – and are only now beginning to recover (U.S.

Department of Agriculture 1998:16-18; Woodbury and Little 1976:6). These forests consisted of species like water mampoo (*Pisonia subcordata*), dogwood (*Piscidia carthaginensis*), wild lime (*Adelia ricinella*), limber caper (*Capparis flexuosa*), ginger thomas (*Tecoma stans*), gumbo-limbo (*Bursera simaruba*), pigeonberry or bodywood (*Bourreria succulenta*), ironwood or lignumvitae (*Guaicacum officinale*), and white manjack. The only remnant of the semi-evergreen rainforest is located in the northwest mountainous region of the island; however, these mountains are not high enough in elevation to generate cloud forests as on Puerto Rico and Jamaica. Plants found in the rainforest include kapok (*Ceiba pentandra*), Jamaican caper (*Capparis indica*), black mampoo (*Guapira fragrans*), West Indian mahogany (*Swietenia mahogoni*), and spiceberry (*Eugenia rhombea*), with an understory that includes limeberry (*Triphasia trifolia*), hairy wild coffee (*Psychotria pubescens*), and painkiller (*Morinda citrifolia*).

Fauna

Faunal species on Caribbean islands in general and St. Croix in particular reflect the diverse yet unique nature of tropical and subtropical island settings. While the number of species may not be large, those that do exist are often unique. This factor is correlated to the distance between island and continental landmass: the greater distance an island is from the continent, the fewer the number of floral and faunal species that island will have, but the greater the distinctiveness of those species will be (Raffaelle 1989:7).

Only 22 native mammalian species have been historically recorded for the Virgin Islands and Puerto Rico (Wiley and Vilella 1999; http://biology.usgs.gov/s+t/SNT/noframe/cr133.htm). Of these species, 13 are living and 9 extinct, and 6 species of the total are bats, including the Red Fig-eating bat (*Stenoderma rufum*), the Antillean Fruit-eating bat (*Brachyphylla cavernarum*), and the piscivorous Greater Bulldog Bat (*Noctilio leporinus*). Extinct species include *Isolobodon portorencis* (rodent) and *Nesophontes edithae* (insectivore). Among the non-bat species are an insectivore, one sloth, and four rodents. Introduced species, such as the mongoose (*Herpestes auropunctatus*), domestic cats and dogs (*Felis domesticus*; *Canis familiaris*), and rats and mice (*Rattus rattus*; *Rattus norvegicus*; *Mus musculus*) have been responsible for the extinction and endangered status of many native bird species (Woodbury and Little 1976:6). Offshore mammals are rare but known as migratory species and are occasionally spotted in the waters between St. Croix and the northern Virgin Islands, and include the sperm (*Physeter catadon*), humpback (*Megaptera novaeangliae*), pilot (*Globicephala* sp.), finback (*Balaenoptera physalus*), and Sei (*Baleanoptera borealis*) whales (Mignucci-Giannoni 1998). The common dolphin (*Delphinus* sp.)

is also regularly seen. It is suspected that manatees (*Trichechus manatus*) were present at the island, based on the presence of manatee bones in the Folmer Andersen Collection.

St. Croix is home to both endemic and unestablished exotic species of birds. For the Virgin Islands as a whole, there are 210 known species of birds, including fossil remains of extinct species, permanent residents, breed and leave, non-breeding migrant and visiting species, and introduced breeders (Raffaelle 1989).

St. Croix is home to few amphibians and reptiles, a pattern found throughout the Virgin Islands. Henderson and Powell (1999:263) credit the low number of Virgin Islands herpetofaunal species to two main factors, 1) low island elevation with a dry climate, and 2) the small size. The Virgin Islands are home to twenty-six species of reptiles, including lizards, snakes (one extinct), and sea turtles. They are also home to seven species of amphibians, including four coquis (a type of frog), the Caribbean white-lipped frog (*Leptodactylus albilabris*), the marine toad (*Bufo marinus*), and the Cuban treefrog (*Osteopilus septentrionalis*) (Wiley and Vilella 1999; http://biology.usgs.gov/s+t/SNT/noframe/cr133.htm). The common tree lizard (*Anolis acutus*) is abundant, and geckos (Gekkonidae) are also present.

The coral reefs of St. Croix provide home to a great variety of reef fishes. Many of those listed are common table fare, including various kinds of snapper, bass, and grouper. Occasionally, large open-water species enter the lagoons and reefs of St. Croix. These species include mackerel, barracuda, sharks, and tarpons.

There are several species of both flora and fauna that are currently listed as either threatened or endangered in the Virgin Islands (U.S. Fish and Wildlife Service 2001; http://caribbean-ecoteam.fws.gov/animals_FS.htm; U.S. Fish and Wildlife Service 2002; http://ecos.fws.gov/webpage_usa_lists.html). Several species of whales are also occasionally spotted in the deeper waters off St. Croix and Puerto Rico, including sperm (*Physeter catodon*), finback (*Balaenoptera physalus*), humpback (*Megaptera novaeangliae*), Sei (*Balaenoptera borealis*), Pygmy sperm whales (*Kogia breviceps*), and Goosebeak whales (*Ziphius cavirostris*). Additionally, killer whales (*Orcinus orca*) have been sighted in the region, apparently following the seasonal movements of their prey (Mignucci-Giannoni 1998:179). The majority of these sightings have been made in the winter and early spring.

Three sea turtle species — leatherback (*Dermochelys coriacea*; endangered), hawksbill (*Eretmochelys imbricata*; endangered), and green sea turtles *(Chelonia mydas mydas*; threatened) — are known to nest on St. Croix. In addition to these, there are other faunal species that have been identified as either threatened or endangered, including the Virgin Islands tree boa

(*Epicrates monensis grantii*; endangered), the Atlantic Ridley sea turtle (*Lepidochely kempii*; endangered), and the loggerhead sea turtle (*Caretta caretta*; threatened).

Changes to the Landscape

Across St. Croix, changes to the landscape began with the arrival of ancient colonizers, who would have cut down portions of the forest to build huts, establish villages and to grow food crops. The also brought non-native animals to the island, including a species of hutia (*Isolobodon portoricensis*), the flightless rail (*Nesotrochis debooyi*), and macaws (Petersen 1997:125). Non-native plants were also introduced, beginning with a few domesticated New World plants brought to the islands sometime around 500 B.C., including maize, sweet potato, manioc, tomato, pineapple, papaya, avocado, cocoa, guava, breadfruit, tobacco, and wild cotton (Cunningham 1997:34).

It was not until the arrival of European colonists, however, and the plantation agriculture economy when large scale deforestation and subsequent changes in rainfall occurred. Desertification, as defined by the United Nations Convention to Combat Desertification, is the degradation of land in arid, semi-arid, and dry sub-humid areas that results from many factors, including climatic changes and human activities (www.unccd.int/main.php, 12/24/03). Land degradation is defined as the reduction or loss of the biological or economic productivity of croplands, range pastures, forests, and woodlands that are rain-fed as a result of human activities and settlement patterns. Urban settings, with decreased vegetation and large paved surface areas result in increased temperatures, called a heat island effect, which can stave off much-needed rain and increase evaporation rates.

Additionally, between A.D. 1600 and 1973, over 50 species of animals have become extinct in the West Indies. These include six species of birds, thirty-four mammals, and ten reptiles, all victims to the destruction of natural habitat and the introduction of new predatory species such dogs, cats, rats, and the mongoose. European settlers introduced sugar cane, coffee, bananas, and citrus to the region.

Much of St. Croix's shoreline, especially surrounding Salt River Bay and what was formerly Krause Lagoon, has been changed over the past fifty years. The shoreline at Columbus' Landing (west side of Salt River Bay) has been altered by the intentional creation and expansion of sandy beaches. When Estate Judith's Fancy (located on the east side of Salt River Bay) was in the process of being developed into a subdivision from the 1960s to the mid 1980s, a marina and a salt water pond were dredged, and fill material was used to create a peninsula and to build up the area immediately surrounding the marina. An artificial crescent beach was also created, flanked by rock jetties, and as previously mentioned a salt water pond was created by dredging beyond the crescent beach. The original shorelines and salt ponds are present on a 1958 U.S. Geological Survey quad map, and when compared to the 1983 maps, the effect of intentional shoreline displacement and dredging for marinas is evident (Figures 9 a and b). The upland and inland areas of Estate Judith's Fancy have been, comparatively speaking, little disturbed; bulldozers were used to remove trees, and today the area is composed of dense scrub vegetation. Krause Lagoon was destroyed in the 1960s with the construction of the second largest oil refinery in the Western Hemisphere.

GEOLOGY OF THE REGION

In general, the islands of the Caribbean are volcanic. They began to be formed nearly 146 million years ago as the North American Plate subducted into the Puerto Rico Trench. This subduction resulted in an upwelling of magmatism and submerged volcanic activity. Slowly, the islands of the Greater Antilles were built. The Lesser Antilles are geologically younger, and because many have been built rapidly some of the islands have little to no sedimentary caps.

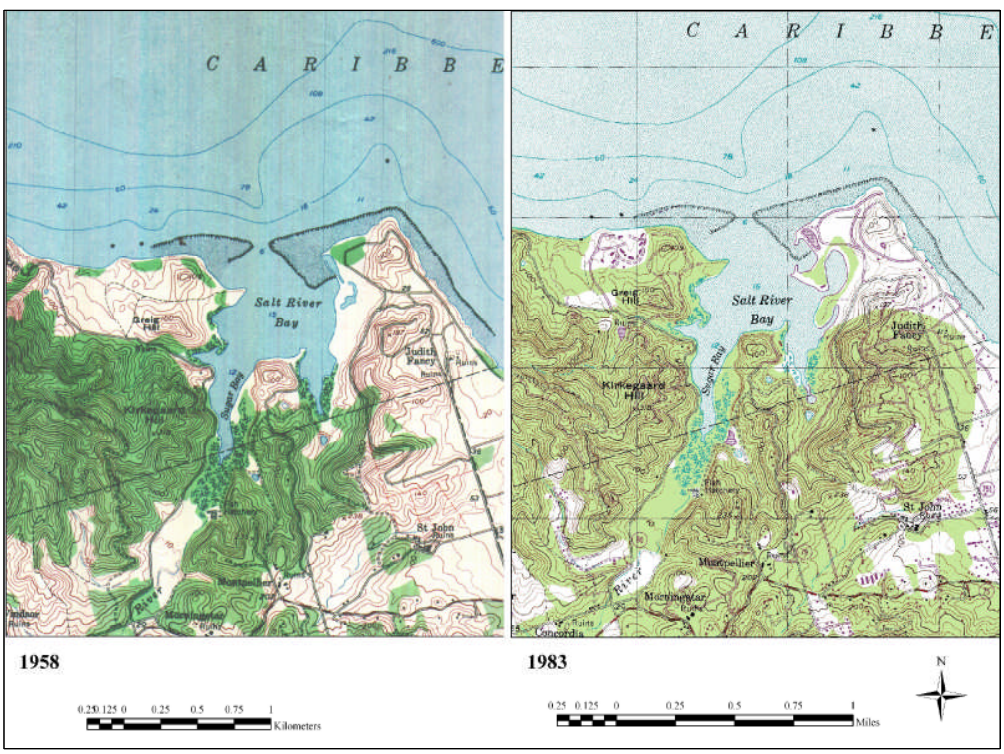


Figure 9a. Changes in the eastern shoreline of Salt River Bay.

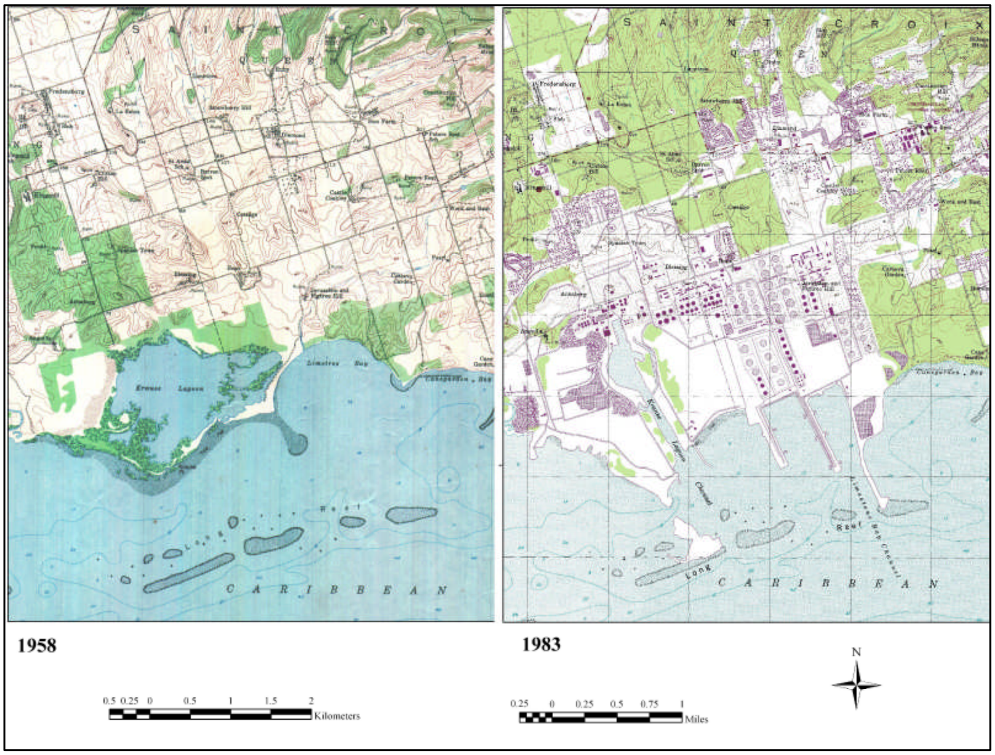


Figure 9b. Changes in eastern shoreline of Krause Lagoon.

Greater Antilles

The islands of the Greater Antilles are the remnants of an extinct volcanic ridge that began forming between the Caribbean and North American tectonic plates during the Early Cretaceous Period, some 146 million years ago (mya) (U.S. Department of Agriculture 1998:18; Speed 1989:9, 19). It is believed that the Caribbean plate began as a submerged oceanic plateau that moved from the Pacific Ocean into the gap between North and South America. The Caribbean Plate is bordered to the north by the Puerto Rico Trench that sinks to a depth of 8,516 meters. The resulting subduction of the North American Plate into the Puerto Rico Trench gave rise to underwater volcaic eruptions, which pushed up the earth's oceanic crust along the margins of the Caribbean plate and folded and faulted the submarine piles of tuff, magma, and ash. At the subduction zone, underwater volcanic eruptions brought olivine to the surface, forming a suite of rocks consisting of serpentine, chlorite, epidote, and albite. These were overlain by sediments that formed into siltstones, mudstones, sandstones, and reef limestones, among others. Tectonic movements folded, uplifted, and faulted these submarine piles, pushing them to the surface.

This period of mountain building ceased during the Eocene epoch (54-38 mya), when the Greater Antilles Ridge collided with the North American continental plate and subduction became focused on the Lesser Antillean arc. The islands of the Greater Antilles, therefore, are composed of both volcanic and sedimentary rocks, some of which were metamorphosed into outcrops of amphibolite, gneiss, and serpintinite. Intrusions of igneous rocks, like diorite and gabbro, are common, and beds or intruding veins of quartz are present. Diorite, gabbro, serpentine, and olivine are associated with the sedimentary islands of the Greater Antilles, and have been identified in bands on St. Croix, Puerto Rico, and Hispaniola. Plutonic igneous rocks (magma that slowly cooled underground), like granodiorite and quartz diorite, that were at one time deeply buried in the core of the island have now been exposed through erosion.

The larger islands of the Greater Antilles all share various traits. During the Eocene (54-38 mya), the region comprised of southeastern Cuba, north-central Hispaniola, Puerto Rico, and the northern Virgin Islands formed a single magmatic arc that split by the Early Miocene. The southern peninsula of Hispaniola junctured with the central portion of the island (Perfit and William 1989). The Cordillera Central (*Massif du Nord* in Haiti) forms the rugged, central mountainous spine that runs east-west on both Hispaniola and Puerto Rico (Bowin 1966), and there are portions that were possibly never submerged (Perfit and Williams 1989). On Hispaniola, a belt or intrusive mass of metamorphic serpentinized peridotite runs northwest to southeast across the central portions of the island. Quartz and calcite can be found locally, and sills or dikes of diorite, hornblende, pyroxene diorite, and/or gabbro are present. The Peravillo Formation contains some pyroclastic materials with fragments of volcanic glass, feldspar, and rare quartzes.

The geology of Puerto Rico is similar to that of Hispaniola and the Virgin Islands, in which faulted and folded sedimentary and volcaniclastic rocks were intruded locally by igneous rocks (Olcott 1999:4). The island consists of three main physiographic areas: an alluvial coastal plain, karst, and a central mountainous interior. Sedimentary rocks, such as siltstones, sandstones, and limestones overlie volcanics, like lava, tuff, breccia, and tuffaceous breccia. There are igneous intrusions, like granodiorite, quartz diorite, quartz porphyry, gabbro, and amphibolite. In the southwestern portion of the island there are large deposits of serpentinite and chert. There is evidence that lava flows in the San Juan district and other areas were andesitic, and vesicules are often filled with quartz and calcite.

Lesser Antilles

Compared to the Greater Antilles, the islands of the Lesser Antilles are geologically young. They began to form around 50 million years ago, during the Miocene era (Perfit and Williams 1989:69; Lindsay et al. 2005). Several of these islands are even younger; Nevis began to form about 3.45 million years ago. The Lesser Antillean arc spans nearly 700 kilometers and consists of 18 volcanoes, many of which are still active. The large southern arc spans north from Grenada to Dominica (known collectively as the Windward Islands), where it splits into two distinct geological belts, collectively known as the Leeward Islands. The eastern (outer) belt is comprised of the islands Marie Galante, Antigua, Barbuda, St. Martin, Anguilla, and Sombrero, known collectively as the Limestone Caribbees, consist of Oligocene volcanic and plutonic rocks that are overlain by a sedimentary cap (limestone). They are lower in elevation than the islands of the Greater Antilles; there are no islands with an elevation greater than 500 m. The western (inner) belt islands of Dominica, Guadeloupe, Montserrat, Nevis, St. Kitts, St. Eustatius, and Saba are composed of volcanic rocks with little to no sedimentary overlay; these are referred to as the Volcanic Caribbees. They are younger geologically, higher in elevation, and have a more rugged topography. The islands of the inner belt are composed of andesitic flows, pyroclastic units, and volcanoclastics that, on some islands, are interbedded with Pliocene and Pleistocene limestones. The outer belt islands are underlain by foramiferal or oolitic limestones.

Like the islands of the Pacific Rim (the “Pacific Ring of Fire”), the Lesser Antilles form a volcanic arc at a subduction boundary, which is fronted by a deep trench called the Aves Ridge. The islands of both the Pacific Rim and the Lesser Antilles tend to produce either acidic or andesitic lavas. Acidic lavas, composed primarily of alkali feldspars, micas and silica, tend to erupt as suspensions of fine ash and not as the more familiar “lava flow.” They often erupt explosively, as plugs form near the surface which allows pressure to build. Andesitic lavas, on the other hand, have magmas that are between basic and acidic, and are common at subduction zones. They occur when basic magma rises through and reacts with continental rocks, and are typically associated with macrocrystalline rocks (quartzes, amethyst, crystals, etc.) like andesite or dacite, but are more commonly associated with cryptocrystalline rocks, like agates, aventurine, chalcedony, carnelian, and jaspers. On islands that produce andesitic lavas, there is the potential for the presence of these kinds of semi-precious stones.

The northern and central parts of the Lesser Antillean arc, from Saba to St. Lucia, are typically stratovolcanoes, with andesite and dacite magmas. The southern group of islands, stretching from St. Vincent to Grenada, have basalts and basaltic andesites and are associated with small explosion craters and lava flows, in addition to stratovolcanoes (Lindsay et al. 2005).

CARIBBEAN PREHISTORY

Much of what is known regarding Antillean prehistory is inferred from data gathered from archeological investigations that have been conducted throughout the Caribbean as well as South and Central America. Although archaeologists have employed different naming conventions for labeling various stages of Caribbean cultural development, the basic sequence of events is fairly well established and is generally divided into five major periods: Casimiroid (a.k.a, Lithic), 4000 – 2000 B.C.; Ortoiroid (a.k.a., Archaic), ca. 2000 – 500 B.C.; Saladoid (Early Ceramic), ca. 500 B.C. – A.D. 600; Ostionoid (Late Ceramic), ca. A.D. 600 – 1492; and Taíno (European Contact), A.D. 1492 – 1550 (Alegría 1983; Bullen 1962; Hatt 1924; Kozlowski 1974; Oliver 1999; Righter 2002a, 2002b; Rouse 1960, 1964, 1986, 1992; Rouse and Allaire 1978; and Wilson 1997) (Table 1). Each of these, in turn, has been subdivided into a number of smaller units that reflect local adaptations of various cultural elements to island environments, as well as the physical movements of and interactions between various groups of peoples from one island to another at various points in time. There are no known Casimiroid or Ortoiroid period sites present on St. Croix.

The Island Life – the Early Ceramic or Saladoid Period, ca. 500 B.C. – A.D. 600

While the focus of this study was Saladoid period ceramics and their possible places of origin, these peoples were not the first to arrive in the Caribbean. The oldest known archaeological sites in the Antilles have been found in Cuba and the island of Hispaniola, and date to roughly 4000 – 3500 B.C. Stone tools that have been recovered archaeologically from these sites are similar to those found on sites on the Yucatan peninsula, suggesting that these earliest Caribbean migrants traveled across the Yucatan Channel from Central America by boat (Wilson 1997:4).

Table 1. Prehistoric cultural chronologies for the Greater Antilles (Based on Rouse 1992 and Wilson 1997).

<table>
<tr><th></th><th></th><th colspan="3">Mona Passage</th><th>Virgin Passage</th><th></th></tr>
<tr><th>B.C.-AD</th><th>Periods</th><th>Dominican Republic</th><th>Western Puerto Rico</th><th>Eastern Puerto Rico</th><th>Virgin Islands</th><th>yB.P.</th></tr>
<tr><td>1625</td><td>IVb</td><td rowspan="2">A=Historic
S=Taino
SS=Classic
C=Taino</td><td rowspan="2">A=Historic
S=Taino
SS=Classic
C=Taino</td><td rowspan="2">A=Historic
S=Taino
SS=Eastern
C=Taino</td><td rowspan="2">A=Historic
S=Taino
SS=Eastern
C=Magens Bay — Salt River III</td><td>325</td></tr>
<tr><td>1500</td><td>IVb</td><td>450</td></tr>
<tr><td>1425</td><td>IVa</td><td rowspan="2">A=Formative
S=Ostionoid
SS=Chican
C=Guyabal/Boca Chica</td><td rowspan="2">A=Formative
S=Ostionoid
SS=Chican
C=Boca Chica/Capa</td><td rowspan="2">A=Formative
S=Ostionoid
SS=Chican
C=Esperanza</td><td rowspan="2">A=Formative
S=Ostionoid
SS=Chican
C=Magens Bay — Salt River II</td><td>525</td></tr>
<tr><td>1250</td><td>IVa</td><td>700</td></tr>
<tr><td>1125</td><td>IIIb</td><td rowspan="2">A=Ceramic
S=Ostionoid
SS=Ostionan
C=Atajadizo</td><td rowspan="4">A=Ceramic
S=Ostionoid
SS=Ostionan
C=Ostiones</td><td rowspan="2">A=Cermic
S=Ostionoid
SS=Elenan
C-Santa Elena</td><td rowspan="4">A=Ceramic
S=Ostionoid
SS=Elenan
C=Magens Bay — Salt River I</td><td>825</td></tr>
<tr><td>1000</td><td>IIIb</td><td>950</td></tr>
<tr><td>750</td><td>IIIa</td><td rowspan="2">A-Ceramic
S=Ostionoid
SS-Ostionan
C=Anadel</td><td rowspan="2">A=Cermic
S=Ostionoid
SS=Elenan
C=Monserrate</td><td>1200</td></tr>
<tr><td>500</td><td>IIb</td><td>1450</td></tr>
<tr><td>375</td><td>IIb</td><td rowspan="2">A=Archaic
S=Casimiroid
SS=Courian
C=Undefined</td><td>A=Ceramic
S=Saladoid
SS=Cedrosan
C=Cuevas</td><td>A=Ceramic
S=Saladoid
SS=Cedrosan
C=Cuevas</td><td>A=Ceramic
S=Saladoid
SS=Cedrosan
C=Coral Bay — Longford</td><td>1575</td></tr>
<tr><td>AD 250</td><td>IIa</td><td rowspan="3">A=Ceramic
S=Saladoid
SS=Cedrosan
C=Hacienda Grande</td><td rowspan="3">A=Ceramic
S=Saladoid
SS=Cedrosan—Huecan
C=Hacienda Grande—La Hueca</td><td rowspan="3">A=Ceramic
S=Saladoid
SS=Cedrosan
C=Prosperity</td><td>1700</td></tr>
<tr><td>0</td><td>IIa</td><td rowspan="2">A=Archaic
S=Casimiroid
SS=Courian
C=El Caimito</td><td>1950</td></tr>
<tr><td>250 B.C.</td><td>IIa</td><td>2200</td></tr>
<tr><td>500</td><td>Ib</td><td rowspan="7">A=Archaic
S=Casimiroid
SS=Courian
C=El Porvenir</td><td rowspan="3">A=Archaic
S=Ortoiroid
SS=Corosan
C=Coroso</td><td rowspan="3">A=Archaic
S=Ortoiroid
SS=Corosan
C=Coroso</td><td rowspan="3">A=Archaic
S=Ortoiroid
SS=Corosan
C=Krum Bay</td><td>2450</td></tr>
<tr><td>750</td><td>Ib</td><td>2700</td></tr>
<tr><td>1000</td><td>Ib</td><td>2950</td></tr>
<tr><td>1250</td><td>Ib</td><td colspan="3" rowspan="5"></td><td>3200</td></tr>
<tr><td>1500</td><td>Ib</td><td>3450</td></tr>
<tr><td>1750</td><td>Ib</td><td>3700</td></tr>
<tr><td>2000</td><td>Ib</td><td>3950</td></tr>
<tr><td>2500</td><td>Ia</td><td>A=Lithic
S=Casimiroid
SS=Casimiran
C=Barrera-Mordán</td><td>4450</td></tr>
</table>

A=Age, S=Series, SS=Subseries, C=Culture/Style.

A second wave of Caribbean migrations that would directly result in peoples colonizing the larger islands of the Greater Antilles occurred sometime around 2000 B.C., the beginning of the Ortoiroid or Archaic period (ca. 2000 – 500 B.C.) (Rouse 1992; Peterson 1997). Many archeologists (e.g., Rouse 1992; Wilson 1997) contend that this migration occurred when peoples from the Orinoco delta region of South America moved northward along the Lesser Antilles until they reached their northernmost extent of the Greater Antilles (Cuba), though their actual origins are little understood. The tools most closely identified with these Archaic cultures are ground stone artifacts, first introduced at this time, as well as blades, small sharp flakes, bone tools, stone celts, and shell gouges (Hayward and Cinquino 2002; Hofman and Hoogland 2003; Kozlowski 1976; Lundberg 1989; Veloz Maggiolo and Ortega 1976; Veloz Maggiolo and Vega 1982). There is also limited evidence that some Ortoiroid peoples used pottery, but whether pottery manufacture and use was a local creation or was an adoption by later populations as a result of contact with Saladoid peoples is unknown (Chanlatte Baik and Narganes Storde 1990; Keegan 1994; Veloz Maggiolo et al. 1991).

Both of these early peoples ate animals such as rodents, hutía, insectivores, manatees, and birds, as well as sea turtles, iguanas, land crabs, and a plethora of reef and seagrass fishes (Petersen 1997:121). Excavations conducted at the Krum Bay site, St. Thomas, Virgin Islands, have produced evidence for a reliance on turtle and shallow water reef fishes (Lundberg 1989; Wing 2001). Local plants also comprised a substantial portion of diet. There is evidence that later waves of Ortoiroid peoples from South America brought with them some horticultural knowledge, as evidenced by remains of wild avocado and yellow sapote that were excavated from the Maria de la Cruz Cave in Puerto Rico, and wild fig, portulaca (purslane), and sapodilla from the Krum Bay site, St. Thomas (Lundberg 1989; Newsom 1993; Newsom and Wing 2004).

Archaic peoples have long been rumored to have been on St. Croix, and archaeological evidence has only recently been obtained in the Salt River watershed (Carlos Solis, personal communication, 2008).

Root crop horticulture and possibly pottery are cultural elements first introduced to the Caribbean islands sometime around 500 B.C., when the bearers of Saladoid culture began to migrate from Venezuela to the peninsula of Paria and the island of Trinidad (Boomert 2000a). Villages throughout lowland Amazonia, in general, followed a consistent pattern settlement and organization typical for many tribal societies around the world — a cleared, central plaza surrounded by structures, surrounded by ringed or partially-ringed middens (Creamer and Haas 1985; Fock 1963; Heckenberger 2002; Hornborg 2005; Lathrap 1970, 1973; Oberg 1955; Oliver 1989; Roosevelt 1980, 1987; Santos-Granero 2002; Siegel 1996; Yde 1965; Zucchi 1973; Zucchi et al. 1984). Linear settlement patterns following major rivers have also been documented (Denevan 1996). They gathered, planted, and grew root crops and a variety of other plants that comprised part of the ancient Tropical Forest agricultural system, including peach palms, peanuts, Lima beans, bottle gourds, cotton, and many kinds of fruit trees. Riverine, lacustrine, and coastal food resources were widely exploited.

These explorers did not pause for long on the small, volcanic islands of the Lesser Antilles, presumably because the environments were not conducive to the reproduction of their Tropical Forest hunting, gathering, farming, and fishing practices; they appear to have first sought out islands with tropical environments similar to those left in the homeland, eventually adjusting their ways of life to better adapt to specific island conditions. They continued to travel north and reached the Virgin Islands and Puerto Rico by ca. 400 B.C.; one of the earliest radiocarbon dates on Puerto Rico is ca. 430 B.C. at Tecla, Guayanilla. Subsequent movements of people following similar paths occurred, perhaps in waves, perhaps as individual voyages. It is believed that Salaoid peoples had some kind of tribal form of social organization, possibly something similar to Big Man societies, with achieved social status that over time could become a hereditary position of leadership (Boomert 2000a, 2001a; Curet 1996a, 2003; Siegel 1989, 1996).

It was at this point that these early Saladoid (also referred to as Early Ceramic) peoples would have likely encountered the descendants of the "Archaic" Ortoiroid cultural groups mentioned above (Curet 1992; Keegan 2000; Rouse 1964, 1986, 1989, 1992; Siegel 1989, 1992). This point will be readdressed further in this chapter.

Saladoid peoples maintained a variety of subsistence strategies, but apparently relied heavily upon both horticulture and fishing/hunting and shellfish gathering (deFrance et al. 1996; Lathrap 1970; Newsom 1993, Newsom and Wing 2004; Steward 1948). Root crop horticulture was practiced with the growing of the starchy manioc. Evidence for manioc cultivation is provided by the presence of ceramic griddles on many archaeological sites; griddles recovered in the lowland Amazon and Orinocan basin of South American have been dated between 2,000 and 500 B.C. The Saladoid also grew and consumed soursop, papaya, sapote, yellow sapote, guava, sapodilla, and avocado (Newsom 1993; deFrance et al. 1996; Newsom and Wing 2004). Other botanical remains recovered from Saladoid period sites in Puerto Rico include goosefoot (Chenopodium), calabash (Bignoniaceae; *Cresentia* sp.), bullytree or jacana (*Pouteria* sp.), wild fig (*Ficus* spp.), and evening primrose (*Oenothera* sp.), among many others (Newsom 1993). Maize may also have been a component of the Saladoid diet, though the extent of its role is currently unknown.

They also fished and gathered shellfish, crabs and/or lobsters, while not abandoning terrestrial species like iguanas and hutias. Among the dietary changes that occurred was a gradual shift from eating crabs to consuming shellfish, as well as hunting hutia, a variety of birds, manatees, iguanas, and sea turtles (Rainey 1940; Wing 1989, 2000, 2001; deFrance et al. 1996).

Archeologists recognize two major decorative ceramic series within Saladoid culture — Huecan and Cedrosan — in addition to daily use or utilitarian wares. Rouse reported (1992:102) that Huecan ceramics are found more often on St. Croix, Vieques, and eastern Puerto Rico, while Cedrosan pottery is typically found on St. Thomas, northern Puerto Rico, and the Mona Passage. Sites on St. Croix like Prosperity, Richmond, St. Georges, and Salt River have produced pottery of both subseries. Reasons for how and why these two distinct ceramic series came to be so disproportionately distributed are currently open to several interpretations. One explanation is that two migrations occurred nearly simultaneously, involving distinct peoples with separate ceramic traditions. A second explanation is that these ceramic subseries represent variation within a single culture, reflecting either different lineage groups or specialized uses.

A third, more controversial alternative is that the La Hueca style represents a separate cultural migration that preceded the recognized entry of Cedrosan Saladoid culture. This Huecan culture, referred to as AGRO I by Luis Chanlatte Baik (2003), is believed to have arrived on Vieques and other islands of the northern Lesser Antilles prior to the entry of the Cedrosan Saladoid (or AGRO II) culture. Chanlatte claims that this Huecoid culture had a distinctive material culture that included unpainted pottery (no red-on-white painted wares), fine zoned-incised cross-hatching decoration (ZIC wares), with red or white staining used only to fill areas of fine incisions or engravings, and a lapidary industry that manufactured finely-crafted ornaments made from non-local, semi-precious stones. Ornaments were also made of shell, mother of pearl, wood (polished black wood), and bone. It is believed that these ornaments sometimes depicted animals not found on the islands but only in the Amazonian and Orinocan basins, such as Andean condors. The fact that some of these semi-precious stones appear to have originated from this same region begs for the argument that a long-distance island-to-mainland exchange network outside of the Orinoco River valley existed at this time. A reexamination of the La Hueca/Sorcé materials and data by José Oliver (1999) has called for a reassessment of this discussion, with future archaeological inquiries focusing on questions of social relations and interactions.

This last alternative has recently received support, at least in the discussions regarding the origins of the forms and styles found on refined stone ornaments and the origins of these stone materials themselves. Harlow et al. (2006) and Rodriguez Ramos (2007) have found that the jadeites used to produce finely carved and string-sawed ornaments originated from the Motagua fault zone in Guatemala. Rodriguez Ramos (2007:218-224) also finds similarities in the styles of these finished ornaments – raptors with heads in claws, segmented frogs, winged pendants ("bat-wing pendants”), and batrachian (tailless amphibians), with those produced in the Isthmo-Colombian region (encompassing the Costa Rica-Panama-Colombia-and Ecuador Intermediate area) that would have been roughly contemporaneous (ca. 150 B.C. and 600 A.D.). Later, the production of *guanine* or *tumbaga*, or a gold-copper alloy that came to replace jadeites as objects of prestige and value throughout the Isthmo-Colombian region, just as the production and movement of “greenstone” ornaments and polished celts and axes ended in the West Indies. He goes on to propose that the origins of ZIC wares was this same region, based on the production of Rosales Zoned Engraved and Guinea Incised styles of pottery, dating from ca. 300 BC. to A. D. 500 (2007:225). However, Rouse and Cruxent (1963:118-122) presented evidence for the presence of zoned crosshatching with the El Mayal style of coastal eastern Venezuela and the Río Guapo style of central Venezuela. Sanoja Vargas also noted (in Gassón 2002:277) the presence of crosshatching (in some areas) associated with Period II of the the Ronquín phase of the Middle Orinoco that dated to ca. A.D. 0 to 300, which also included white-on-red, red-on-buff, white-on-buff, white and red-on-buff, punctation, and modeling. The discussion regarding the possible origins of these stone ornaments will be resumed in Chapter 5, and without a direct comparative study of the variety of potential candidates for the original cultures of ZIC wares, this second debate will have to remain unanswered. The primary debate on the origins of Caribbean ZIC wares has been between Chanlatte Baik and Irving Rouse (Chanlatte Baik 2003; Rouse 1992). After twenty-some years of debate, both parties agreed that the Saladoid and La Hueca groups diverged from a common cultural group in South America, likely near Venezuela’s northeast coast. Questions regarding who entered the West Indies first, or if these were actually two separate cultural groups, remains to be answered.

Whichever explanation may be the case (or any combination thereof), Huecan subseries pottery typically consists of zone-incised and crosshatched (ZIC) designs normally restricted to vessel rims and flanges, while Cedrosan pottery has fine white-on-red painting (WOR wares) (Figures 10 and 11) (Righter 1997:73). At both the Sorcé and Punta Candelero sites (on Vieques and Puerto Rico, respectively), in addition only a few additional sites throughout the region, ZIC wares are found in separate middens and are associated with WOR, while the middens containing predominately WOR wares and other Early Saladoid objects do not contain ZIC wares.

In general, Saladoid pottery is thin-walled and hard-fired, and includes inverted bell-shaped bowls, with open and flaring rims more common than restrictive or straight rims, and carinated vessel walls (Allaire 1997:22; Righter 1992). Other vessel traits include double bowls, globular vessels, pierced lugs or tabular handles, and D-shaped handles (Hayward and Cinquino 2003).

Saladoid pottery incorporates polychrome paints, like purple, black, yellow, and orange, as well as zoomorphic and anthropomorphic figures (*adornos*) (Petersen 1997:23).

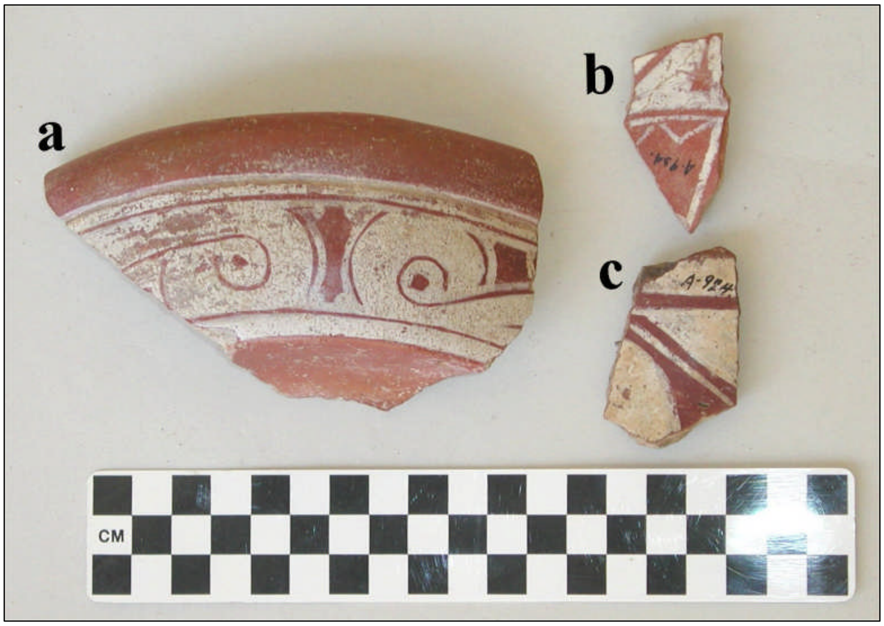


Figure 10. White-on-Red Wares (WOR), Prosperity style, Early Saladoid. Cat. #s: a, A-235 (2730); b, A-934 (2428); c, A-924 (2422). Folmer Anderson Collection, courtesy of Christiansted National Historic Site, Christiansted, St. Croix. All of the artifact photos, unless otherwise noted, were taken by the author.

Figure 11. Zoned-Incised Wares (ZIC), Early Saladoid. Cat. #s: a, # A-939 (2465); b, A-947 (2471); c, A-942 (2468); d, A-941 (2470). Folmer Anderson Collection, courtesy of Christiansted National Historic Site, Christiansted, St. Croix.

It is important to introduce the topic of ceremonial use and symbolic status importance of both WOR and ZIC wares. Both WOR and ZIC wares require skill in ceramic technology, the ability to make films and paints, and skill in the execution of designs. Because of the skill levels required for their production, it does not seem likely that these were daily use wares, but were made by at least part-time specialists for particular reasons, whether ritual, feasting events, or individual status symbols. Likewise, there have been few studies of utilitarian wares from this period, such as large cooking pots, griddles, beer brewing vessels, and daily food consumption bowls. This discussion will be elaborated upon in Chapter 5.

Stone, shell, and bone tool kits included awls, knives, flake tools, bone points and harpoons, hooks, metates, grinding stones, adzes, and celts (Figure 12). Groundstone objects were made and used (Hayward and Cinquino 2002). Some petaloid celts show evidence of having been highly polished and were possibly solely used for ceremonial purposes, while others were used for grinding or pecking objects. There is some evidence that polished celts that broke were then used as tools, conceivably because they lost their symbolic value. Other artifacts associated with Saladoid culture and daily life activities include carved shell masks, pendants made of shell and turtle bone, stone net sinkers, ceramic spindle whorls, and coral hammerstones (Figure 13) (Righter 1992:27).

Figure 12. Used groundstone adzes and other tools (a, b, c, e); d, possible whetstone. Salt River site. A, b, e cat. #s 33154; c, 33157; d, 33156. Fewkes Collection, courtesy of the National Museum of the American Indian, Washington, D.C.

Figure 13. Carved shell ornaments. Cat. #s (left to right): 1598, 1594, and 1673. #1673 is a non-native naiad shell, likely from South America. Folmer Andersen Collection, courtesy of Christiansted National Historic Site, St. Croix.

Three-pointed figures made of stone, wood, clay, or shells were present throughout the Saladoid culture region, and were initially called *zemis* by early archaeologists (Figure 14). It is now known that *zemis* used by the Taíno at the time of European contact were representations of specific deities; the function of the three-pointers remains unknown (Rouse 1992; William Cissel personal communication, 2002). Early versions were small and simple, while later versions (during the Ostionoid) became quite large and were elaborately carved. Other ritualistic activities that were practiced include the use of *cohoba*, a hallucinogenic mixture of powdered *cohoba* seeds or bark (*Anadenanthera peregrina*) mixed with tobacco that was inhaled through the nose; there are reports from Spanish observers of Taíno that ash or lime from shells was added to the mix. Early Saladoid religious paraphernalia also incorporated zoomorphic images of SouthAmerican fauna, including tapirs, capybaras, caimans, monkeys, and jaguars (Rodríguez 1997:85). Over time, these images changed to resemble local faunal species, such as turtles, manatees, rays, pelicans, and ducks.

Early Saladoid villages are often located in ecotones, or areas where two or more ecological zones converge. Villages tend to be located in close proximity to mangroves, estuaries, continual or intermittently running fresh water, lagoons, coral reefs, and soils amenable to horticulture or agriculture. They are also located along watersheds and near river mouths, and associated with alluvial soils (Morse 1989).

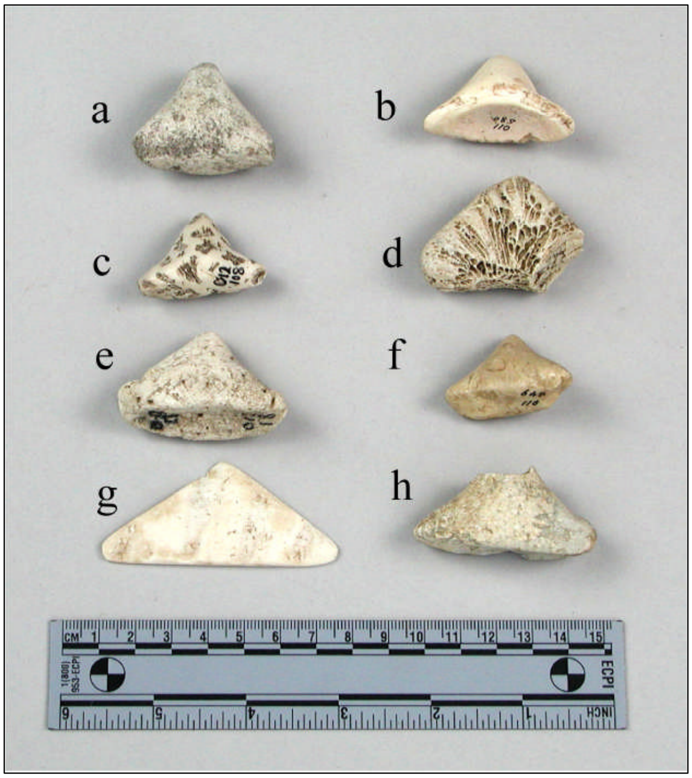


Figure 14. Three-pointers of stone, shell, and coral. Salt River site. A, cat. #12.235; b, 11.580; c, 12.108; d, 11.656; e, 12.18; f, 11.649; g, 12.67; h, 11.588. Gudmond Hatt Collection, courtesy of the Danish National Museum, Copenhagen, Denmark.

Communities consisted of houses clustered around central cleared plazas, often interpreted as multifunctional areas that would have often been used for ceremonial functions (Rodríguez 1997:84). Evidence from sites like Indian Creek, Antigua (Rouse and Morse 1999), Maisabel, Puerto Rico (Siegel 1991, 1992), Villa Boqueron, Puerto Rico (Goodwin and Walker 1975), Golden Rock, St. Eustatius (Versteeg 1989), Richmond and Salt River, St. Croix (Hatt 1924, Vescelius 1952), and Tutu, St. Thomas (Righter 2002) all have a consistent pattern of settlement that holds with an Amazonian patterns: a cleared, central plaza surrounded by structures, further ringed by circular or U-shaped middens (Creamer and Haas 1985; Fock 1963; Lathrap 1970; Oberg 1955; Roosevelt 1980, 1987; Yde 1965; Zucchi 1973; Zucchi et al. 1984). In general terms, the Saladoid pattern consists of several large round houses, ranging from over 10 m to approximately 32 m in diameter, built of poles and thatch. It is believed that these structures housed extended families (Keegan 2000:141).

Saladoid burial customs included interment in middens surrounding the sacred plaza space, and in the central plaza itself as a kind of cemetery (Curet and Oliver 1998; Righter 2002; Sandford et al. 2002:220). Interred individuals are often recovered in flexed, tightly flexed, or in seated positions (Hardy 2007; Sandford et al. 2002; Winter et al. 1991), though Siegel (1992) reports several extended burials at the Maisabel site on Puerto Rico. Prestige goods have been reportedly recovered from middens surrounding the central plaza and not with individuals, possibly indicative of egalitarian reverence in death; these items include polished stones, carved shell and bone amulets, carved stone beads, effigy ceramic vessels, and plain or carved three-pointers. Many individuals have been recovered with pottery vessels placed near the head, covered with vegetal fibers (mats or woven goods), and/or often headed east. These practices have been recorded at Maisabel and Punta Candelero, Puerto Rico, and Salt River, St. Croix (Budinoff 1991; Siegel 1992; Curet and Oliver 1998; Crespo Torres 1991; Hatt 1924; Rodríguez 1997:83). Excavations at the Tutu site on St. Thomas revealed that both subadults and adults of the early Saladoid period, buried in the plaza area, were often interred with pottery (Righter 2002). Keegan notes (2000:144) that those goods found with a few burials are likely personal possessions, and could be indicative of personal achieved status. These practices burying the dead in central spaces in unmarked graves, as summarized by Curet and Oliver (1998), is indicative of kin-based corporate groups with social organization possibly largely on lineal descent. Instances where differential burial practices are used at the same location (i.e. in central spaces and middens), then these practices could be indicative of variable social group membership or affiliation, and perhaps status.

As previously discussed, the social organization of Saladoid communities has generally been interpreted as egalitarian, based largely on an apparent absence of hierarchical patterns of settlement, burial, and artifact distributions. However, this terminology does not account for the variability of forms and the appearance of ranks and temporary hierarchies as found in middle range societies.

Ostionoid (Late Ceramic) Period, ca. A.D. 600 – 1492

By ca. A.D. 400, Late Saladoid cultures were being influenced by yet another wave of cultural changes that were beginning to spread throughout the Caribbean. A number of archeologists recognize several possible sources for these influences: innovation by Saladoid groups, trade and interaction with other groups, such as peoples of the Barrancoid cultural groups that originated from the llanos region of central Venezuela and northeast Colombia (also known as the Intermediate or Isthmo-Colombia region) (Boomert 2003:147); originally, it was believed that Barrancoid traditions had evolved out of Saladoid cultures of the Lower Orinoco (Allaire

1997a:25; Rouse 1992:92). Eventually, these traits emerged in both the Mona Passage and the Virgin Passage, including on he islands of Vieques, Puerto Rico, and the Virgin Islands (Allaire 1997:25), a cultural and stylistic period commonly referred to as Ostionoid.

Ostionoid culture then developed into two regionally based cultural variants: Elenan, distributed from Guadeloupe to eastern Puerto Rico (including the Virgin Islands), and Ostionan, located in western Puerto Rico and Hispaniola (Rouse 1992:107). Some researchers, however, hold that two distinctive cultural phases developed out of Saladoid phases; the Ostionoid phase comprised the western half of Puerto Rico and the Mona Passage, and the Elenoid phase was located in the eastern half of Puerto Rico, Vieques, and the Virgin Islands. However, these "boundaries" are not fast, in Ostionoid phase wares have been observed in the eastern part of the region, and *vice versus*.

Between A.D. 600 and 900, these two Ostionoid regional variants spread across the Caribbean and diverged into four new subcultures, again without hard and fast boundaries: (1) Elenan (Virgin Islands, Puerto Rico, and the Leeward Islands down to Guadeloupe); (2) Meillacan (those Ostionans who moved west of the Mona Passage to north-central and western Hispaniola, Jamaica, and Cuba); (3) Chican (Ostionans of eastern Hispaniola and Cuba); and (4) Bahamian Ostionan (the remainder of the Greater Antilles and the Bahamian Archipelago) (Rouse and Allaire 1978). However, some researchers believe that Meillacan wares were actually a local innovation, produced by Archaic Ortoiroid groups who learned pottery making technologies (Keegan 2000; Rouse 1992; Veloz Maggiolo and Ortega 1995).

By A.D. 400, many of the long distance trade networks that had existed during the Saladoid period were no longer in use (but by ca. A.D.1200, are reported to have been revived) (Rouse 1992:126). Archaeologists have commonly referred to this period as a "dark age" (Rouse 1992:133), a period of cultural devolution prior to the development of complexity and social hierarchy that evolved into the Taíno chiefdoms and marked by an absence of effigy vessels, figurines, masks, and intricate decorations on pottery. Recent studies of societal "dark ages," however, have revealed that they are actually components of dynamic cyclical processes of reproduction and system crisis (Chew 2007:13). These studies have drawn largely from ecological models of systems and complexity, in which crises provide opportunities for system transition and reorganization. Curet contends (1992b, 1996a) that an argument for cultural impoverishment does not hold when evidence for increasing political, economic and religious complexity has been archaeologically recovered.

As populations increased and villages either grew or budded off, a need for further self definition of in-group status membership developed. The use of fine ceramics and limited exotic stone beads and amulets were no longer enough to differentiate between elite and commoner status groups. New symbols were developed and adopted as means of indicating status and, by ca. A.D. 900 (prior to a resurgence of trade and interaction networks), included ornately carved three pointer stones and *zemis*, *duhos* inlaid with shell and gold, and ornately carved semi-precious stones.

The growing of manioc and using of clay griddles remained a mainstay of Ostionoid subsistence, but new agricultural practices were developed and adopted (Rouse 1992:109, 134). For example, agricultural fields were often mounded, and along with irrigation and terracing, crop yields would have increased and possibly led to a steady rise in the island's population (Curet 1996:119). These people employed deep-sea fishing techniques and collected shellfish. It was also during this time that corn (*Zea mays*) was introduced from South America (Rouse 1992:109).

During this time, villages became hierarchically ordered, but the basic settlement pattern remained the same. Some villages remained small and may have served as agricultural hamlets or activity camps while others grew to be regional centers of power (Curet 1992b, 1996a; Rouse 1992; Siegel 1992, 1996). These centers, in turn, were hierarchical, some with only one plaza and others containing multiple plazas. It has been hypothesized that the dance and ball courts observed at some Chican village sites evolved out of the Saladoid settlement practice of clustering houses around the central plaza, alluding to a continued significance of these spaces (Alegría 1983; Rouse 1992). The ball and dance court (*batey*) developed in eastern Hispaniola and Puerto Rico and then spread to other islands, along with other elements of Chican culture (Morse 1997; Rouse 1986). They were also sometimes established over the Saladoid plaza cemeteries, further evidence for their continued ritual significance (Alegría 1983; Curet and Oliver 1998). Other objects recovered archaeologically that are associated with activities at these courts are "stone collars," "elbow stones," and stone balls. Similar plans of ball and dance court complexes, marked by earthen embankments or carved stones, and similar styles of ball-game artifacts, like elbow stones and stone belts are long known in Meso-American contexts, though there exists no evidence supporting a direct Meso-American influence on Greater Antillean cultures (Alegría 1983; Rouse 1964:510).

Ostionoid religious and burial practices apparently developed largely out of earlier Saladoid traditions, with subsequent influences from Chican cultures. Human burials reflected a general shift in emphasis toward the family unit, and were directly related to individual structures or houses, though people in some places continued to be interred in the central plazas (Curet 1992a, 1992b, 1996:120; Righter 2002; Sandford et al. 2002). There have been reports from other islands that burials also occurred in caves. Grave goods interred with some individuals are believed to be indicative of social status (Rouse 1992:116).

Elenan and Chican ceramics are typically poorly proportioned, with flat bases, thin rims, and raised loop or strap handles; they are often polished and painted completely in red or red smudged with applied or modeled zoomorphic images (Righter 1992:27; Rouse 1992:124). Chican ceramics are typically incised with curvilinear designs and have incurving shoulders. Chican pottery is typified by carinated bowls and decorated with incised and punctated designs and elaborate lugs, and flat bases decrease in popularity. Ceramics from Salt River and other sites across St. Croix demonstrate some stylistic affinity with eastern Puerto Rico and the Dominican Republic, such as the Boca Chica and Ostiones styles. As will be discussed in Chapter 5, there are also geochemical similarities between the ceramics of these areas.

Zemi figures still prevailed, only now being much larger and more elaborate. They were incorporated into both ceramic vessels and other art forms, like vomiting spatulas and statuettes. Chican influences on the use of *zemis* are marked by the carving of these objects into representations of humans and island animals, in conjunction with geometric designs similar to those found on Chican pottery. Many of the late Ostionoid *zemis* are representations of both male and female Taíno deities (Rouse 1992:118). *Zemis* were also represented as petroglyphs in caves, and carved on stone outcrops and stones used to line *bateys*. Zoomorphic figures on pottery and *zemis* no longer represented South American fauna, but depicted local species.

The *cohoba* ritual was also practiced by Ostionoid peoples, and items associated with this ritual include snuff platforms on top of *zemis* and individual wooden or bone tubes were used for *cohoba* inhalation, as opposed to earlier pottery vessels that encompassed inhalation tubes.

Other changes in subsistence include a marked shift from land crabs (typical of Saladoid sites) to marine mollusks (Rainey 1940), though results from more recent research indicate that neither one of these foods were major dietary components (de France et al. 1996; Keegan 2000). Other fauna that were eaten include sea turtles, spiny lobsters, iguanas, birds, queen conch, and a variety of fish.

Ethnohistorical Accounts of the Late Ostionoid Hereditary Hierarchies

While not the focus of this study, a brief summary of the Taíno societies encountered by Columbus and his crew is the natural end of the discussion of prehistoric peoples in the Caribbean.

By 1492, the Ostionan cultures of the Greater Antilles and the Leeward Islands had become hereditary chiefdom societies that were encountered by Columbus and his contemporaries, commonly referred to today as Taíno. Much is known about these cultures from fifteenth and sixteenth century observations, though it should be remembered that these historical accounts are biased recordings made by Catholic clergy and Spanish explorers and officials. These recordings do not document all aspects of Taíno life, nor do they fully comprehend and describe the social complexities of kinship and exchange relationships. Moreover, observations of Taíno life did not encompass the entirety of the Caribbean, or even the Greater Antilles, but only those on Hispaniola, Puerto Rico, and Cuba that are today attributed as the Classic Taíno culture area. Finally, the word Taíno was not used these peoples to describe themselves; it was placed on all of the cultures of the Greater Antilles encountered by Columbus that demonstrated the basic tendencies of chiefdomship by the time of Sven Loven's *Origins of the Tainan Culture, West Indies* (1935). It was not used by Fewkes (1913), de Booy (1917), or Hatt (1924). This word artificially categorizes all of the peoples of the region with some form of possible hereditary status as comprising a single cultural and ethnically defined group.

These chiefdoms were two-tiered hierarchical societies, with elite and commoner classes. Leaders (*caciques*) were also hierarchical, with local, subregional, and regional *caciques* responsible for many villages. The villages were hierarchical, with the classes living in different kinds of dwellings. Residential patterns were based on the social hierarchy; the *cacique* lived in the largest house (*caney*) located at one end of a plaza or ball court (*batey*).

Agriculture was a central part of daily life, providing the Taíno with foodstuffs, material culture, and the basis for their religious practices (Highfield 1997:165). It is believed that corn was not a major constituent in the Taíno diet, due to an absence of documented and named deities or *zemis* associated with corn harvest. There are, however, named deities for manioc/cassava, which indicates the cultural importance of this food plant (Petersen 1997:128; Rouse 1992:12). Fruits that were cultivated and eaten by the Taíno included *yayagua*, or pineapples (*Ananas comosus*), *hobo* and *hikako*, the coco or West Indian plum (*Chrysobalanus icaco*), papaya (*Papaya carica*), and *guannaba* or soursop (*Annona muricata*). They also collected palm nuts, guava berries, and *guáyiga* roots. Wild cotton was used to make sleeping hammocks, clothing, storage nets, and fishing nets (Olazagasti 1997:135-137).

The Taíno were skilled boatsmen and navigators. They built and maintained large canoes for interisland travel by hollowing out large trees, and the largest of could have been used as to travel to the South American coast (Keegan and Maclachlan 1989:614; Olazagasti 1997:133). Many items were traded between the islands, such as cotton, ground and polished stone beads, raw stones, ornaments and tools made of shell, bone, stone, and wood, tobacco, foods, and feathers, among other items (Deagan and Cruxent 2002:38; Rouse 1992:17). Women reportedly made and traded particular goods equated with elevated status, including *duhos* and items made of cotton (Keegan and Maclachlan 1989:618). Women also maintained the *conucos*, while men fished and helped with the planting and harvesting of crops.

At the same time, the Island Carib or *Kalinago* (Cooper 1997:186) were raiding the islands of the Lesser Antilles, taking women and children as wives and servants (Rouse 1992; Cooper 1997; Boomert 1990; Santos-Granero 2002). It is believed that when Columbus' men arrived at St. Croix on November 14, 1493, they encountered Taíno people who had been recently conquered by Island Carib invaders (Boyer 1983:2; Cohen 1969:138-139; Morse 1997:36; Rouse 1992: 146). However, some researchers argue (Hatt 1924; Honychurch 1997:294) that many of the Island Carib that were encountered by Columbus and his men were actually Arawaks who had been influenced culturally by mainland Caribs. This argument continues to be the subject of much debate.

CRUCIAN CHRONOLOGY AND TYPOLOGY

In 1924, Gudmond Hatt of the Danish National Museum established the first prehistoric chronology for St. Croix and the Virgin Islands that, for the most part, has remained intact. The chronology was divided into three diachronic components, a pre-ceramic tradition (Krum Bay), and two ceramic traditions, Coral Bay — Longford and Magens Bay — Salt River. The Coral Bay — Longford tradition consists of ceramic traits found throughout the Lesser and Greater Antilles that are today described as Early or Cedrosan Saladoid, such as red-on-white and red-on-black painting, polychrome painting, ZIC wares, inverted "bell-shaped" vessels, and griddles, in addition to three pointer stones and beads and amulets carved of both local and nonlocal stone. The Magens Bay — Salt River tradition consisted of ceramic traits found most notably across the Greater Antilles in midden levels above the Coral Bay — Longford ceramics, roughly equivalent with today's Late Salaoid or early Ostionoid and continuing into the Late Ostionoid series (Elenan and Chican, or Taíno).

Vescelius (1952) also analyzed settlement patterns and site distributions. All but one of the Early Saladoid period sites known as of 1951 were located either on the coast or in the coastal plain; the one exception is the St. George site, located in the middle of the island.

Vescelius noted (1952) the presence of a few ceramics that possibly represented trade wares at certain sites. During the Saladoid period (Rouse's Period IIb, or the Coral Bay — Longford period) there were ceramics of the Palo Seco style from Trinidad: 14 from Salt River, six from the Richmond site, and two from the River site. Later during the Magens Bay — Salt River II and III (Periods IIIb and IV) periods, both Capá (from western Puerto Rico) and Boca Chica (from eastern Dominican Republic) style ceramics were recovered; Boca Chica style wares were recovered from the Manchenil (n=23), Hermitage 2 (n=15), Salt River (n=13), Cramer Park (n=11), and Fair Plain (n=6) sites, while 9 Capá style sherds were found at the Manchenil site. Their presence on St. Croix could be indicative of trade or of particular exchange ties and partnerships. Those wares representative of the Magens Bay — Salt River II and III periods are possible evidence for developing interaction spheres among the Vieques Sound region that eventually became the Taíno region of influence. There is additional evidence for the presence of Santa Elena and Esperanza styles, but it could not be determined if these decorative styles were the result of parallel development or represented actual trade wares.

Irving Rouse (1964:503) initially called the Ostionoid cultural complex of the Virgin Islands Magens Bay — Salt River, and has since divided it into an earlier Magens Bay-Salt River I (ca. A.D. 550 – 1200) and Magens Bay — Salt River II (ca. A.D. 1200 – 1492).

Alfredo Figueredo (Figueredo and Winter 1986) noted preferences for settlement location that changed over time. During Period IIa (Prosperity phase), sites tended to be located almost exclusively in wide fertile bottomland plains, and large villages were centrally located inland, and not along the shore. By Period IIb (Coral Bay — Longford phase), there were a wide variety of villages, ranging from small to large in size, and by Period IIIa (Magens Bay — Salt River I) some villages were centrally located along lee shores, arguing for a developing settlement hierarchy and relations between “parent” and “satellite” communities. During Period IIIb (Magens Bay — Salt River II), nearly every ecological setting contained small and middle-sized communities, with marked preferences for lee shore beaches and hilltops adjacent to fertile bottomlands. Finally, Figueredo (Figueredo and Winter 1986) noted that by Period IVa (Magens Bay — Salt River III) there were large villages located at the seashore, and decreasing numbers of small, isolated communities. This could represent greater nucleation of populations at growing villages

Figueredo established an “Aklian” cultural pattern specifically for St. Croix, referring to specific adaptations of Saladoid culture on the island in which the descendants of the earlier Saladoid populations occupied and made use of various environmental niches (Table 2). Settlements then spread to more inland areas (Winter et al. 1991). The Aklian pattern can be viewed as a “transitional phase” between the Saladoid and Ostionoid/Elenan phases, dating to roughly the same period as Vescelius’ Period IIb, ca. A.D. 350 – 650 (Figueredo and Tyson 1986:

C-1). Aklian ceramics represent a simplification of earlier, more elaborate Saladoid pottery, in which polychrome painting was abandoned and decorative elements were simplified, yet vessel forms remained the same.

Table 2. Chronology and cultural series for Vieques Sound Region and St. Croix (adapted from Figueredo and Tyson 1986).

Period	*Series*	*Subseries*	*Culture/Style*	*Pattern (Figueredo)*	*Pattern (Vescelius)*	*Years*
IVb	Unknown	Eastern/ Taíno	Taíno	Unknown	Esperanzan (Fair Plain)	A.D. 1509 – 1718* A.D. 1500 – 1625
IVa	Taíno / Ostionoid	Eastern/ Chican	Taíno	Chican	Cramerian (Cramer)	A.D. 1250 – 1509*; A.D. 1250 – 1500
IIIb	Ostionoid	Elenan	Santa Elena; Magens Bay — Salt River II	Elenan	Elenan (Salt River)	A.D. 950 – 1250*; A.D. 1125 – 1425
IIIa	Ostionoid	Elenan	Monserrate; Magens Bay — Salt River I	Magensian	Richmondian (Richmond)	A.D. 650 – 950*; A.D. 500 – 1125
					Longfordian (Longford)	
IIb	Saladoid	Cedrosan/ Cuevan	Cuevas; Coral Bay — Longford	Aklian	Cuevan (Mint)	A.D. 350 – 650*
IIa	Saladoid	Cedrosan/ Huecan	Hacienda Grande — La Hueca; Prosperity	Cuevan — Cedrosan	Cedrosian (Prosperity)	A.D. 150 – 350* A.D. 50 – 150*
Ib	Carneroid/ Ortoiroid/ Archaic	Corosan	Krum Bay	Krumian		
Ia	unknown					

Righter (1992:26) subdivides the last seven of the Coral Bay — Longford sites into a separate subseries, based on Vescelius' "Cuevan" subseries that dates to A.D. 350 to 600. The ceramics of this subseries demonstrate a gradual increase in the use of a monochrome painted finish rather than white-on-red painting, red painting on the shoulder or lip, thick rims, reverse shoulder curvature, flat or concave bases, and polishing.

The prehistoric chronology for the northern Virgin Islands has been recently revised to reflect the close relations and affiliations between these communities and those of eastern Puerto Rico. However, it is important to note that the northern Virgin Islands are not necessarily culturally related to St. Croix; this association is a by-product of colonial-era grouping of these islands by European powers beginning in the eighteenth century. Prior to its ownership by

Denmark beginning in 1734, St. Croix was a separate colony from the northern Virgins, and the island was not included with the *Once Mil Virgines* by Columbus during his visit in 1493.

Both Morse (1989, 1995, 2004) and Lundberg and Righter (1999) found that changes in ceramic styles on St. Croix and throughout the Virgin Islands indicate that close cultural affinities were possibly maintained with communities in eastern Puerto Rico and eastern Hispaniola. Many of the style attributes demonstrate continued contact with the developing Ostionoid chiefdom societies. It was proposed that these relations could have been established during Saladoid times.

Table 3. Chronology and cultural series for St. Croix used in this text (adapted from Morse 1995, 2004 and Rouse 1992).

Periods (Rouse)	***Series***	***Subseries***	***Phase***	***Years***
IV	Ostionoid	Chican —Taíno	Magens Bay — Salt River III	A.D. 1200 – 1500
IIIb	Ostionoid	Elenan	Magens Bay — Salt River II	A.D. 900 – 1200
IIIa	Ostionoid	Elenan	Magens Bay — Salt River I	A.D. 600 – 900
IIb	Saladoid	Cedrosan	Coral Bay — Longford	A.D. 400 – 600
IIa	Saladoid	Cedrosan	Prosperity	200/100 B.C. – A.D. 400

The prehistoric chronology for St. Croix today demonstrates the cultural relations to Puerto Rico, eastern Dominican Republic, and the rest of the Greater Antilles, and is largely based on the work by Hatt (1924) and Irving Rouse (1992), and modified locally by Morse (1995, 2004). The periods, series, and subseries, styles and modes are as follows: Prosperity (ca. 200/100 B.C. – A.D. 400) and Coral Bay — Longford (ca. A.D. 400 – 600), phases of the Cedrosan Saladoid subseries and corresponding to Rouse's Periods IIa and IIb, respectively; Magens Bay — Salt River I (ca. A.D. 600 – 900) and Magens Bay — Salt River II (ca. A.D. 900 – 1200), phases of the Elenan Ostionoid subseries and corresponding to Rouse's Periods IIIa and IIIb, respectively; and Magens Bay — Salt River III (ca. A.D. 1200 – 1500), reflecting the later infusion of Chican cultural influences into the Virgin Islands at the end of the Ostionoid period and corresponding to Rouse's Period IV (Table 3) (Figures 15 through 19).

Figure 15. WOR, with white used to fill in incised spirals. St. Georges site, cat. # 2747. Folmer Andersen Collection, courtesy of Christiansted National Historic Site.

Figure 16. ZIC-like ware, with red film, incised curving lines and knobs. Richmond or St. George site, cat. # 2476. Folmer Andersen Collection, courtesy of Christiansted National Historic Site.

Figure 17. White-on-Red wares, Coral Bay – Longford phase. Glynn site, cat. # 2383. Folmer Andersen Collection, courtesy of Christiansted National Historic Site.

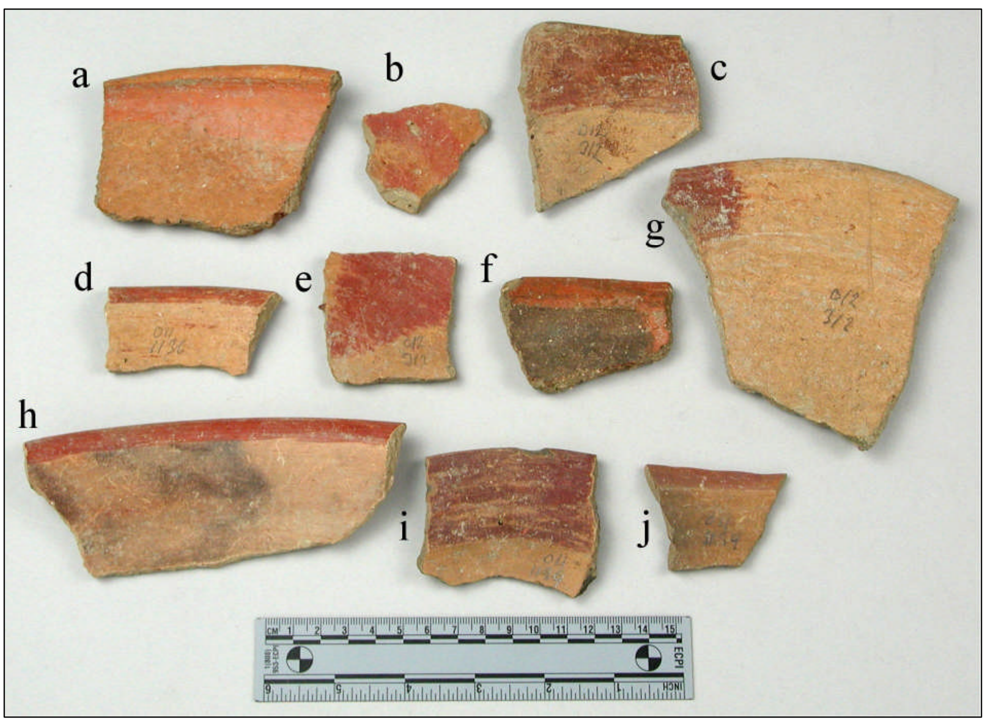


Figure 18. Red on rim, Coral Bay – Longford or Magens Bay – Salt River I style ceramics. Salt River site, cat #s: a, b, 11/1118; c, e, g, 12.312; d, h, 11.1136; f, 11.1113; i, j, 11.1134. Gudmond Hatt Collection, courtesy of the Danish National Museum, Copenhagen, Denmark.

Figure 19. Infant burial bowl, Magens Bay – Salt River II or III phase, red film and carinated. Salt River site, # 14.2. Gudmond Hatt Collection, courtesy of the Danish National Museum, Copenhagen, Denmark.

THE ARAWAKAN ETHOS – EXCHANGE, INTERACTION, AND COMPLEXITY IN LOWLAND AMAZONIA

As discussed above, at least one physical migration of peoples occurred from Lower Orinoco River to the islands of the Lesser and Greater Antilles. These people, in turn, were the cultural descendants of societies that were undergoing a divergent trajectory of social organizational development in Lowland Amazonia (Figure 20). Much of this section is pulled from both archaeological and ethnographic studies and publications from research throughout the region. While there are many problems that may arise when using ethnographic analogies for interpretation of archaeological material culture, they can, when pulled from multiple relevant sources, contribute some understanding of past human behavior as evidenced in the archaeological record (Waterson 2000:178).

Today it is recognized that across the Northern Amazonia/Orinoco region there is a region-wide sharing of a variety of cultural traits, generally termed as an Arawakan Ethos. As described by Heckenberger (2002), Hornborg (2005), Hill (2002, 1984), Santos-Granero (2002), Whitehead (2002, 2003), and others, this ethos consists of a regional set of values, perceptions, beliefs, customs, and practices found among peoples and communities with different kinds of socio-political organization and languages linked in a loosely-organized network. There are several principle elements that define the Arawakan Ethos (Santos-Granero 2002:47).

1) The avoidance of endo-warfare.
2) The tendency to develop increasing levels of sociopolitical alliances between linguistically related peoples. This may involve both alliance building between many villages under a paramount chief, and interethnic alliances.
3) A variable and flexible social life, based on descent, consanguinity, and commensality, possibly indicative of House-like societies.
4) Flexible political leadership based on ancestry, genealogy, and inherited rank.
5) Religion is a central role in daily life: personally, socially, and politically. There is an elaborate mythology with elaborate rituals and specialists to perform them.
6) Extensive interaction and exchange spheres, which were also interethnic.
7) The presence of a sacred geography, based in myths of original ancestors, culture heroes, and their travels through the landscape. Sociopolitical relationships are encoded in representations of space, and historical knowledge is inscribed in the landscape (Vidal 2003:35).

The above list is not a trait list regarding archaeological categories of sociopolitical types (as described in Chapter 2), the primary differences being that the above "traits" are not requirements for membership in social categories but evidence for participation in a broad interaction sphere. Not all Arawakan groups today share all of these traits.

These qualities are first observed in the archaeological record between the second and first millennium B.C., with the beginning of a massive Arawakan expansion evidenced by similarities in ceramic style, settlement pattern, the planting and processing of manioc inferred by the presence of ceramic griddles, and in some cases the presence of polished "greenstone" tools and ornaments, *quirípa*, and *guanín*. There is also the occasional presence of bone flutes, and quartz beads possibly used in rattles. These peoples took over floodplains and dominated trade routes, built alliances, and many were likely multilingual (as evidenced by early European explorers in the region). These cultures changed and transformed as they encountered others through processes of ethnogenesis, defined as:

> How societies emerge and re-create themselves in history through a series of transformative episodes, during which people, cultures, and languages of diverse origins joint to create new, hybrid and original ethnic constructions
>
> [Campbell 2001:540].

There were complex and extensive trade networks that used rivers, tributaries, and coasts as conduits for moving goods from the highlands to the north and west to the lowlands of Amazonia (Cody 1990:135-143; Gassón 2002; Heckenberger 2005, 2002; Heinan and García-Castro 2000; Lathrap 1973). "Access to rare prestige goods from remote areas were, here as elsewhere, an important foundation for ritual and political-economic authority" (Hornborg 2005:594). Various communities and societies went to great lengths to obtain objects laden with both regionally and locally important symbolic meaning and value. Boomert (2000a:424) cites three primary valuables that were exchanged throughout lowland South American and the southern Caribbean, primarily through two broad spheres of exchange: *guanín* or *tumbaga* (an alloy of gold and copper that was hammered into a variety of shapes), ornaments and beads carved out of a variety of green semi-precious stones into a variety of animal forms, and *quiripá* (small beads or disks originally made from the apex of freshwater shells).

These two spheres of exchange were largely geographically confined – green polished stones, green stones carved into a variety of animals including, lizards, raptorial birds, turtles, and bats, and frogs (*muiraquitãs)* in eastern Amazonia, and *quirípa* in the northwest. They were traded among "Big Men" and other types of leaders during marriage transactions (Boomert 1987:37). Spanish observers recorded that frogs carved of green and red stones were used in exchange for wives among the Taíno chiefdoms of the Greater Antilles (Lovén 1935:478-479).

Throughout lowland Amazonia, *muiraquitãs* have been recovered from sites associated with the Kondurí and Santarem cultural complexes (ca. A.D. 400 – 1500) from the lower Amazonian Marajoara, and complexes of the "Amazonian Polychrome Tradition" (ca. A.D. 500 –1500) (Hornborg 2005:594). Other pendants, representative of frogs, birds, fish, and turtles, have been recovered from cemeteries associated with the Valencia cultural complex of Venezuela's central coast (ca. A.D. 100 – 1500), though these items were made of locally available stones like serpentine, serpentinite, and limestone (Boomert 1987:40-46).

Both *quiripá* and *guanín* are known to have been moved and traded throughout lowland South America for thousands of years; *quiripá* have been recovered from the Cedral site, located in the Orinoco Llanos near the Apure River, in association with greenstone animal-shaped pendants that dates to ca. 680 ±50 B.C. (Gassón 2000:587). Pieces of *guanín* have been recovered from several sites across the region with Saladoid occupations. Similar copper-based gold alloys were made and exchanged widely, from the Central Andes to northwest Colombia, Northwest Amazonia, Costa Rica, and elsewhere throughout northern South America, and appears to have been related to a common symbolic value system held throughout the Isthmo-Colombian and Lowland Amazonian region for objects with luster, shine, and reflectivity (Falchetti 2003; Helms

1987; Saunders 2003). Evidence for goldwork predating the existence of the Tairona chiefdoms of Colombia has been recovered from the burial mound at Nahuanga, dating to ca. A.D. 310 ±70 (Bray 2003:326). Associated with the gold objects were over 8000 stone beads, nephrite and jade-like objects, shell artifacts, and caches of pottery vessels. Falchetti notes (2003:364) the symbolic importance of particular jade, gold, and gold-copper alloy ornaments in trade networks and relations among groups of the northwestern Amazonia and the Isthmo-Colombian region (Colombia-Costa Rica-Panama Intermediate Area). Gold also replaced jade as objects of prestige in prehistoric Costa Rica, sometime between ca. A.D. 500-700 (Snarskis 2003:161).

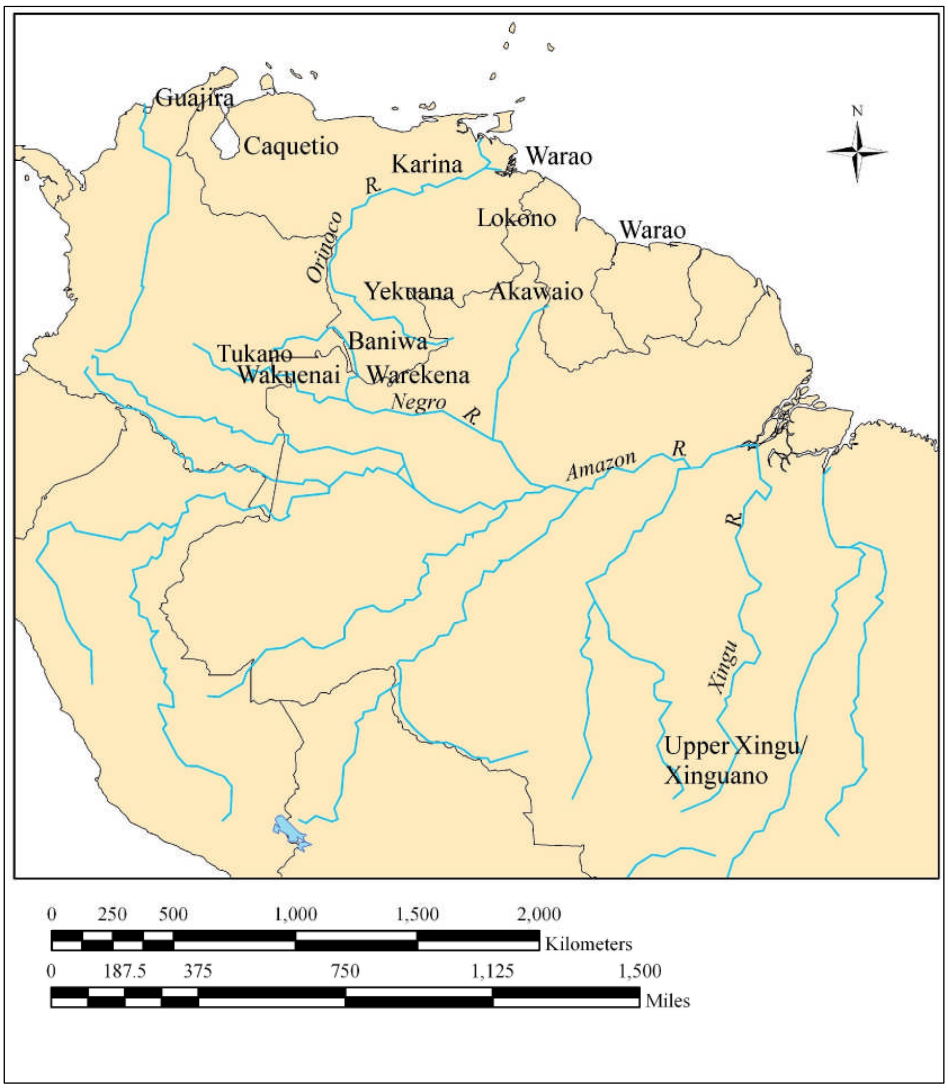


Figure 20. Map of Amazonian groups and distribution across landscape, as discussed in this chapter.

Three extensive trade networks are known to have converged on the central Orinoco region (Hornborg 2005:594). From the north and east came Caribs who brought blowguns, arrows, baskets, curare (arrow poison), dyes, and pearls to obtain *quirípa*, turtle oil, smoked fish, gold and salt. Arawaks brought forest and savanna products to the northern area in exchange for gold, salt, cotton textiles (from Chibchan chiefdoms in the northern Andes), and they brought gold and curare to the south for *quirípa*, turtle oil, and smoked fish.

Historically in the Guianas and throughout northeastern South America, Carib (Kalinago) and Arawakan groups often warred but would also put aside their differences and come together to trade specific kinds of goods. The relations between these two groups were complex and not are well understood. As stated by Arie Boomert (1990:89), trade and war were inseparable amongst the Kalina and the Arawak, and "regular barter between traditionally hostile tribes appears to have been the rule." Kalinago on the islands often traded with Arawak, especially for high-valued goods from the mainland of northern South America. Commerce between the many Amerindian tribes of the Tropical Forest region of northeastern South America was hardly interrupted by war. Specific trade and exchange relationships were developed, demonstrating a kind of "fictive kinship" in which partners exchanged names.

Santos-Granero notes (2002:33) that Arawakan speakers of Northwestern Amazonia were central in the development of interethnic alliances and networks that were hierarchical in political formation, multiethnic and multilingual, and based on economic specialization. Memberships in these alliances and confederations changed over time, but there are some overriding similarities from the sixteenth through the early nineteenth centuries, especially between the northwestern Arawakan groups and Tukanoans: exogamous patrilineal sibs, which were organized into exogamous patrilineal phratries; origin myths associated with the emergence of hierarchically ranked sibs, and rites using sacred trumpets. The entire region is comprised of "a variety of societies displaying Arawakan and Tukanoan cultural traits in different combinations. Both groups raided and feuded, took women and children as spouses and servants, and practiced war cannibalism" (Santos-Granero 2002:37).

The Orinoco Basin societies were highly interactive and integrated, despite having a great variety of socio-political structures. The region was connected through what Gassón (2000:585) refers to as an Orinoco Regional Interdependence, based on "tribal peer polity exchange." These regional connections of interdependence and interaction spread with the physical Arawakan Diaspora, and included Northwest Amazonia, the Guiana coast, and the islands of the West Indies, where establishment of political alliances through kinship (real or fictive) established and maintained, and goods were exchanged in order to maintain social relations. Groups in the

Venezuelan llanos were also communicating and trading with peoples of the Colombian Andes and possibly the Isthmo-Colombian region, as discussed above. Over time, the broad Arawakan Interdependence Region slowly diverged into smaller, more localized regions that, while still maintaining some ties to the outside, primarily focused on developing relations within an increasingly restricted sphere of interaction by the Late Saladoid period.

A Lower Orinoco interaction sphere has been proposed by Arvelo-Jímenez and Biord (1994:56), Boomert (2000a), and others (Gassón 2002) as one of these localized regions. Arvelo-Jímenez and Biord (1994) suggest that a system of restricted exchange developed not out of economic necessity and control of localized resources, but for the development and maintenance of socio-political alliances and relations with neighboring societies of varying ethnicities. Helms also referred to a Caribbean Interactive Sphere, which linked together the peoples of the Greater Antilles, northeastern Venezuela, and the Guianas (1987:76). By the Late Saladoid period, a network of ceremonial exchange had emerged that revolved around the Lower Orinoco Valley and Barrancoid culture area. The localized Lower Orinoco Interaction Sphere included the South Caribbean and the Lesser Antilles. At the same time, Saladoid peoples of the northern Lesser Antilles and Puerto Rico were developing a new regional interaction zone.

A third region that emerged is today commonly referred to as Northwest Amazonia, where groups have long been recognized as constituting a large regional interaction area; these groups include Tukanoan, Arawakan, Cariban, and Makuan language speakers. The multiethnic Northwestern Amazonian Arawakan, Tukanoan, and Maku societies are well known for their multilingualism, the use of *lingua franca* (Tukano), and their abilities to build alliances among both Arawakan and non-Arawakan communities. Heckenberger notes (2002:113) that Arawakan groups in Northwest Amazonia today are typically organized into a two-tiered hierarchy of elites and commoners that closely resembles conical clans or "House societies." Specific phratries control particular territories and the use of certain rivers and tributaries, in addition to the resources located in these territories (Heckenberger 2002; Hill 1983; Sorensen 1967). They practice cross-cousin marriage with uxorilocal residence, and are organized into sets of longhouses (Houses) speaking the same language. Their sociopolitical relations and historical knowledge are both "encoded in their representations of space" and onto the landscape itself (Vidal 2003:35).

As a side note, there are similarities in stylistic traits and decorative elements between the Saladoid peoples of the Caribbean and the Isthmo-Colombian region (spanning from Costa Rica, Panama, Ecuador, and Colombia, connecting Central America to the Andes and northwest Amazonia) that are typically viewed as symbols of status or high social rank. The use of bat wing pendants, spirals, “bird man” motifs, a variety of green stones carved into vulture/condor/raptor and frog images, the use of quartz crystals in rattles and as pendants, carved and polished ornaments and other objects of black wood, and the later use of *guanín* or *tumbaga* all point toward common shared symbolic motifs affiliated with notions of the sacred, the maintenance of social relations, and ethnic and/or social identity (Helms 1987:74). Decorative elements observed on ceramics, such as crosshatching, also demonstrate these possible interactions. These similarities in decorative elements on some ceramics, carved stone ornaments, and the stone materials themselves (jadeites and nephrites) has also been presented by Rodriguez Ramos (2007; as discussed earlier in this chapter) as evidence for long distance trade-based relations between circum-Caribbean groups, namely between the Isthmo-Colombian region, Northwest Amazonia, and the islands of the West Indies. However, in order to prove these relations hard evidence of trade that goes beyond mere similarities in symbolic representation; in other words, both chemical evidence for the movement of goods from region to region and the identification of sources of raw materials is needed to substantiate these possible macroregional relations. While there are stylistic similarities between the winged pendants of the Isthmo-Colombian region and those of the West Indies, Cruxent and Rouse (1963:Pl. 29A) also note the presence of bat-wing pendants at Trujillo in western Venezuela, evidence of interaction relations that were occurring throughout western Venezuela, Colombia, and southern Central America.

Many of the exchange relations throughout northern Amazonia are defined in local cosmologies. For example, Heinan and García-Castro (2000:562) describe a complex interethnic network for the Warao of the lower Orinoco, based largely on subsistence specialization as defined and described in their Haburi culture hero myths. People in the northeast quadrant of the Warao world are described as gatherers and fishers of the swamplands, while those of the northwest are fishing specialists. Those to the southeast were regarded as hunters, and those of the southwest as horticulturalists; the southwestern horticulturalists include the proposed homelands of Saladoid-Barrancoid peoples. Authority was based on the abilities of headmen and chiefs to control long distance trade in both valuable prestige goods and local goods, in order to establish and maintain political, social and kin relations.

In Northwest Amazonia around the Vaupés, creation myths define the specialized economic roles of various Arawkan and Tukanoan groups. Among the Xinguano of the southern Amazon, the creator Tuangi defined village economic specialization and the sociopolitical networks by giving particular goods he made to various groups (Heckenberger 2005:229).

Sacred geography among Arawakan groups and their neighbors is how the histories of events and peoples are memorialized on the landscape. Toponyms represent the homes and travels of mythological ancestors and culture heroes, and "reflect a knowledge of riverine geography that is…connected to Arawakan trade routes" (Hornborg 2005:591). Relations between toponyms and "historical consciousness," and acts as a means of inventorying all the resources in a particular area: spiritual, economic, natural, and social (Vidal 2003:50-51). The relations between toponyms and mythology are perhaps best identified with the Kúwai myth cycles of Arawakan groups of Northwest Amazonia, which developed in the eighteenth century as a reaction to encroachment by Europeans onto sacred and ancestral lands (Vidal 2000, 2003). The journeys of Kúwai are encoded on the landscape as sacred places and routes, known as Kuwé Duwákalumi, or "where Kúwe passed by." This cartography is representative of places deemed important through historical relations between sociopolitical, religious, and economic spheres of life (Figure 21) (Vidal 2003:35).

Sacred lands, hills, and pools are demarcated by peoples of Colombian Northwest Amazon with petroglyphs, believed to be the dwellings of supernatural beings, the keepers of game and fish (Reichel-Dolmatoff 1971:121; 1987:7; Wright 1992:129). Among the Xinguano of the Southern Amazonia, sacred space is defined both in the village itself as a realization of cosmology realized in chiefly power, and throughout the landscape as defined through myth, stories of ancestors, and "remembered events" (Heckenberger 2005:225-226). Relations between community (sib) rank and location are also present among the Xinguano, where the most sacred places of origin and the ancestors are located downstream (north) from lesser important sites to the south (Heckenberger 2005:227). The most sacred place, however, is the center of the village plaza.

Finally, among Tukanoan groups of the Vaupés and Pirá-paraná regions of Northwest Amazonia, social hierarchies are realized on the landscape through their sacred geography as defined by creation myths. In short, higher ranking sibs are typically located near river mouths and junctures with tributaries, while lower ranking sibs are located near the headwaters (C. Hugh-Jones 1988:20). The ranking of sibs is based on the order of emergence of their original ancestor, a son of the Primal Sun Anaconda, from the Primal Sun Anaconda once it had swam up the Milk River (Amazon River), reached the center of the world, turned to face east, and gave birth to the first humans (S. Hugh-Jones 1988:152; C. Hugh-Jones 1988:33). This same pattern of higher ranking sibs located downstream of lower ranking sibs is also found among Arawakan Warekena (Vidal 2003:51).

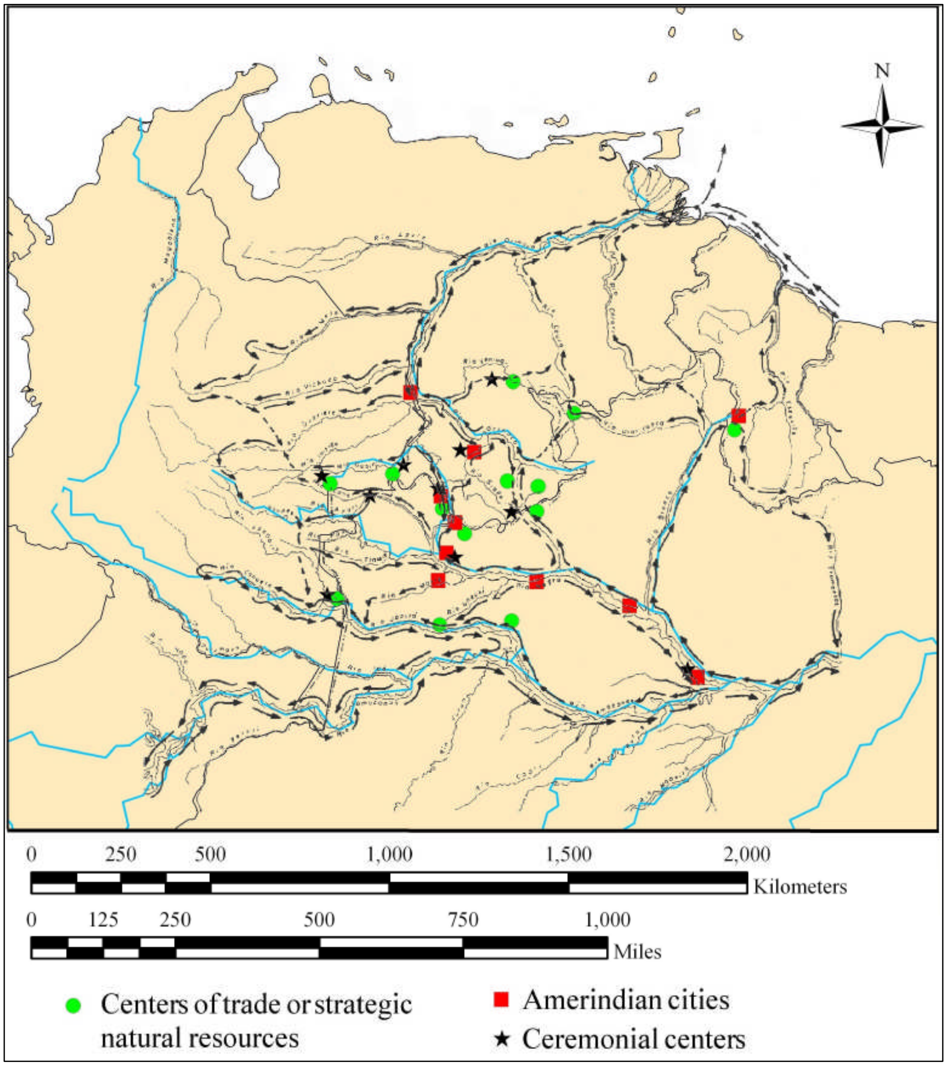


Figure 21. Map of Kúwai routes. Adapted from Hill 1983; Vidal 1993; Vidal 2000.

Both Arawakan and non-Arawakan groups throughout lowland South America share a generalized mythology that can essentially be divided into two sets of cycles. The first cycle centers on the creation of the world and the establishment of hierarchical order, defined and described by particular geographies and territories, symbols, occupations, and ritual instruments (S. Hugh-Jones 1988; Reichel-Dolmatoff 1971; Roe 1982; Vidal 2000; Zucchi 2002). For some groups, these first myth cycles involve one-way journeys of the sons of a "spirit of spirits," who comes to earth and is responsible for either the creation of humans and/or is the discoverer of knowledge, value, and wisdom (Stevens-Arroyo 1988:208); for other groups, like the Warekena, this element is found in the second group of myth cycles. The hero does not return to his primordial home, and sometimes the journey is actually a banishment for disobedience (Stevens-Arroyo 1988:214).

The Tukanoan creation myths briefly described above are similar to those for the Cubeo (Goldman 1993:142-143), who also incorporate the Arawakan mythic culture hero Kúwai, but in this case considered as the creator of humans while thinking on a ritual stool. He creates the ancestral spirits, and they are born as anacondas at rocky rapids. The anacondas gradually shed their scales, and the emerging human infants travel the rivers. The ancestors then begin to settle at particular places on the river based on their birth order; the first born is located at the mouth, while the last is at the headwaters.

The origin myth of the Warao (lower Orinoco) explains the division of the world into quadrants (as described earlier) and the birth of Haburi, the inventor of the dugout canoe (Wilbert 1993:65). Haburi's mother and her sister were fleeing an ogre, and sought refuge in the house of Wauta (tree frog-woman), who lived in the southwest quadrant and was a farmer. Haburi grew quickly, and unwittingly committed incest with his mother and aunt. They had to flee the frog-woman, who learned of the incest, so he created the canoe and they went to the northern world mountain, the home of Naparima (water god); here they remained. The canoe and paddle changed into snakes, the canoe into a red snake (female) and the paddle into a white snake (male). The snake-woman and paddle-man returned to the center of the earth, where the red snake-woman became Dauarani, the Mother of the Forest.

There are two sets or versions of Taíno creation myths that were documented by Father Ramon Pané on Hispaniola during the early sixteenth century (Pané 1999). The first involves the birth of Yayael to Yaya (the "spirit of spirits"). Yayael wanted to kill his father, and was banished for four months. Yaya then killed him, and placed his bones in a gourd hung from the roof of the house. One day, Yaya wanted to see his son, and as his wife turned the gourd over many fish fell out. They then ate the fish.

Later, Yaya was away tending his inherited lands (*conucos*), when four sons were born to a woman (Ita Cahubaba) who dies in childbirth. The sons are cut out of the woman's womb, and the first removed was named Deminán, who was scabby (syphilitic); none of the other brothers were named. While they were eating they realized that Yaya was returning and quickly attempted to hang the gourd (the same gourd that held Yayael and transformed his bones into fish), but it fell and broke, and released so much water that it covered the earth. The water was filled with fish, and thus the ocean was created. The brothers fled and went to the door of Bayamanaco, the "Spirit of Fire" and the instructor on the rites of cohoba, medicine, and cassava. The four twins stole fire and cassava, and the rites of *cohoba*. Bayamanaco spit on the back of Deminán, and a large swelling grew and turned into a turtle. The four twins then cut the female turtle (Caguama) off his back, which then mated with the brothers and gave birth to humans. The shell became the sacred house where the human race was conceived from the brothers and the female turtle. At the end of his journey, Deminán was cured of his disease.

The second groups of cycles are based on the voyages of a primordial human who has made mistakes and broken societal rules. When the hero returns he has learned his lessons and becomes a better person, developing into the idealized leader and a societal role model. These myths typically establish social order and rules of marriage.

The second myth cycles of the Warekena (and Wakuenai) describes how the second Kúwai, the half-human son of the creator of the first world, Nápiruli (Iñápirríkuli), and the primordial woman Amáruyawa (Amáru) (Hill 1983, 2002; Vidal 2000, 2003); the first myth cycle tells of the creation of the earth, and its eventual destruction by a great flood. Because Nápiruli and Amáru were of the same patrisib, the conception was considered incestuous. Amáru dies in childbirth, and Nápiruli takes Kúwai to live in the sky, then brings Amáru back to life. Eventually, Kúwai is discovered, and his father invites him back to the village. Kúwai sings and chants and opens the world; as he travels throughout the world he sings all the animal species into existence. He teaches all the chants, including those for agriculture and the sacred initiation rituals, to the first ancestors. When he is finished with the last chant, Nápiruli pushes him into a great bonfire and he dies. The world begins to shrink back to its original size. From his ashes grows a large tree, and when Nápiruli chops it down the logs become the mouthpieces for sacred flutes and trumpets. Amáru and the women steal the sacred instruments, and are chased for a long time by the men. Nápiruli and the other men trick the women, and get back the instruments. These second cycle of myths describe the origins of rites of initiation, and the creation of secret male societies and warrior organizations. The sacred instruments (*Yurupari*) are symbols of a men's society that are responsible for their care. These secret male societies are also referred to as the Yurupari "cult," and are found among both Arawakan and Tukanoan groups throughout Northwest Amazonia (S. Hugh-Jones 1988:4-5).

The Taíno myth of Guahayona illustrates how men attain chiefly authority through patience, control, and by acting for the collective (Stevens-Arroyo 1988:137). In this myth, Guahayona convinces all the women to leave their husbands and children, and his brother-in-law, the chief, to go with him from one of two primordial caves at Mount Cauta to the island Matininó, which is hidden from men. Guahayona tricks the chief to look into the water, pushes him in, and continues with all the women to the island. The children were left behind and cried *toa toa*, wanting to nurse. They were changed into frogs, and are now known as the voice of spring. Guahayona leaves the women on the island and continues to another island named Guanín. He realizes he left a woman (Guabonito) in the bottom of the sea; he goes to retrieve her, and they return to Mount Cauta. He is now full of syphilitic sores, and wishes to be cured. Guabonito sends him away to a special place to be cured, and he is. When she asks if she can continue her journey, he says yes, and in return she gives him *guanines* and *cibas* (stones similar marble, worn on the arms and neck). Guabonito leaves and Guahayona stays with his father, and from this point on he is referred to as Guanín.

The origins of these Taíno myths are derived from those of the Saladoid period ancestors, with lowland Amazonian-South American roots that share many important elements with other Arawakan myth cycles dating back some 2000 years (Gassón 2000, 2002; Heckenberger 2002; Hornborg 2005). These shared myths and their cultures of origin are indicative of former participation in a multiethnic region of exchange and communication that included regionally important and defined values. Elements shared by these multiethnic communities include participation in "cosmopolitan" interaction spheres, specialized roles of production and movement, possible linguistic exogamy, cross cousin marriage, and grouping of ranked and named sibs into Houses (Longhouses or Malocas) with ranking based on their ancestor's birth order as defined by origin myths. Over time, these symbols and values developed into regionally specific meanings and interpretations, as defined by more localized sacred geography and changes in mythology, and realized in new notions of prestige value and symbolically laden material goods like ornaments and decorations on pottery.

Status, Rank, and Hierarchy?

Social inequality may be expressed symbolically in many forms, such as monumental architecture and elaborate burials. It can be identified by the presence of particular objects, like sacred flutes, ornaments and other goods made of exotic, non-local resources. Inequality may also be demonstrated by behavior, attributed by those within a community to an individual or their family who are associated with a particular skill that requires specialized knowledge.

Santos-Granero states (1986, 2002) that political power of Amazonian shaman-chiefs is embedded in economic processes. These individuals maintain a monopoly over ritual techniques to such an extent that "power and ideology, ritual and production are related to generate political authority" (Santos-Granero 1986:657). In Amazonia, "power (political) is linked to control or possession of life-giving knowledge, ceremonial techniques, and ritual phenomena (to promote life, fertility, and prosperity by transferring life from objects abounding in it to objects deficient in it" (Santos-Granero 1986:658). He argues that "political power in Amazonian societies is based on the leader's positive mystical intervention in productive and reproductive processes that their power is economic" (Santos-Granero 1986:659).

The Wakuénai, normally socially egalitarian on a daily basis, have a hierarchy of ritual and ceremonial specialists, shamans and chanters. The hierarchy is evident in the ranking of patrisibs, orders in each phratry that were based "in accordance to the mergence of sib ancestor spirits in myth" (Hill 1985:2). These were part-time specialists, and particularly charismatic ones could potentially become headmen that would lead by example, not by force.

Status and internal hierarchical ordering of sibs is established through the creation myths of the Tukanoan-speaking peoples of the Vaupes and Pirá-paraná region of the Northwest Amazon. The highest status attributed in the Desana hierarchy is given to the priest who is a direct representative of the "solar divinity," and to the *payés*, or shamans and leaders of religious rituals. These are followed by heads of sibs, heads of families, and initiated youths (Reichel-Dolmatoff 1971:249). The hierarchical ranking of named sibs is based on the order of the emergence or birth order of the sons (brothers) of the Primal Sun Anaconda, (S. Hugh-Jones 1988:152), as alluded to earlier. Higher ranking sibs live near river mouths or the confluences of streams and rivers, and are affiliated with the head of the anaconda; lower ranking sibs live at the headwaters, associated with the anaconda's tail (Goldman 1993:145; Reichel-Dolmatoff 1971:14).

The process of building the maloca of Tukanoan groups is itself indicative of hierarchical rank and status. The malocas of those men who can get the help of their male kin to build the house, and who own a set of sacred instruments, are good orators, and have other status items often become regional ceremonial centers. These houses become "arenas for demonstrating powers and prerogatives, and set an official seal on the current constitution of political groups and on current claims to status" (Hugh-Jones 1995:243).

Among the Cubeo, the traditional and historical concepts of the hereditary chief had two forms, sacred and secular. The sacred leader bore the name of the sib's founding ancestor, and was represented as the head of the anaconda and mouth of the river (Goldman 1993:150). The secular Head Man dealt with practical matters, and was selected based on skills. Over time, the secular leader has developed into a hereditary position. The secular leader is the most powerful, and is considered a "symbolic heart that supplies soul force to everyday life" (Goldman 1993:151). Below the chiefs and ritual leaders are the shamans, and below them, warriors.

Status is also attributed to those with special knowledge of making particular objects. The high status of the master canoe maker (*moyotu*) among the Warao is based largely on his ability to distribute wealth to his parents- and brothers-in-law. The ability to make and own a large seagoing, five-piece vessel enables him to conduct long-distance and overseas trading trips to Trinidad (Wilbert 1993:58). The *moyotu* "is chosen to become initiated as a workman of the goddess Dauarani, the patroness of the master builder of canoes" (Wilbert 1993:61). In this sense, the *moyotu* is recognized as a person of good moral character, who has knowledge and control of the supernatural.

If we take the common elements of these Arawakan societies and attempt to build on the concept of an Arawakan Ethos, or, for lack of a better term the "Proto-Arawak" Ethos, the following can be inferred. First, there was extensive alliance building between linguistically related groups, possibly via long and medium-range trade relations that met during trade fairs, competitions and festivities, and various ritual events. However, this is not necessarily always the case, as many Amazonian groups build alliances and marry across linguistic "boundaries." Second, possible interphratric warfare would occur only when certain elements of rituals were not met, or from avenging murders, fights over fishing rights, etc., and there was a general avoidance of endo-warfare. Third, there was an emphasis on descent, consanguinity, and commensality. Hereditary leadership and/or rank would have been maintained through marriage to other high-status families or between high ranking patri-sibs of different phratries. And finally, social and political power heterarchy were (and are) based on shamanic power and the ability of an individual to control the sacred. Religion and ritual, therefore, formed the core of daily life.

This view of ancient Amazonia as heterogeneous and complex, with internally developed and flexible varieties of social ranking and inequality, stands in sharp contrast to older, entrenched views that these elements were brought to the region from outside. Lowland Amazonian cultures were initially associated with non-complex forms of social organization, as stated in Steward's 1948 *Handbook of South American Indians*, and were grouped together as the Tropical Forest Cultures (Lowie 1948; Steward and Faron 1959). The Tropical Forest Culture was considered one end of a spectrum of cultural evolutionary stages, above the marginal tribes of South America but below the advanced Andean civilizations on the other end, while the Circum-Caribbean chiefdoms were somewhere "in between" the two extremes; the Taíno chiefdoms of the Greater Antilles were included in the Circum-Caribbean, which also included the chiefdoms of northern Venezuela, Colombia, Panama, and Costa Rica (Steward 1974 (1947)). Steward's theory was, in fact, a continuation of Osgood's "Theory of the H" as established in 1943, where Venezuela was viewed as the "connecting bar" between main migration routes along both the Western coast of the Americas and, later, down the continent's eastern coast (Osgood and Howard 1943; Oliver 1989:15). It was believed that all of Venezuela's prehistory and the emergence of the Circum-Caribbean cultures had diffused eastward from the Andean societies.

Cultural traits were believed to have followed distinctive paths down the Andes, across the Amazon Basin, and up and down the Caribbean and Atlantic coasts.

Betty Meggers and Clifford Evans (Meggers 1954, 1971) took the reins on this perspective, stating that complex means of social organization migrated down from the Northwest (Ecuador) toward the Amazonian Basin. They contended that the people of lowland Amazonia could not "attain more than a minimal level of complexity without a concentrated and productive food supply" (Meggers 1971:7). Because of high temperatures and high rainfall, Meggers held that soils were rapidly depleted of nutrients and therefore could not produce the surplus foods necessary to sustain large populations, ergo complex hierarchical societies. Gardens can be clear cut and burned but could only be used for two or three years. The appearance of monumental earthworks and elaborate pottery on the island of Marajo, at the mouth of the Amazon that dated to ca. A.D. 1000-1500, was believed to have been due to cultural traits that diffused down from the Andes.

Jose Cruxent and Irving Rouse (1958, 1961) also recognized Venezuela's (and the Orinoco Valley) role as a "crossroads" between the Andes and the Caribbean coast. The eastern (Lower Orinoco) and western (Maracaibo Basin) ends of the Orinoco River were viewed as centers of cultural development that were strongly influence from all directions: Central America, Andes, the Caribbean coast, and northern Amazonia. Venezuela was therefore not just a west-east conduit for cultural interaction, but served as a point of cultural generation that was influenced by surrounding regions.

On the other hand, Donald Lathrap (1970, 1973) claimed that the center of cultural development and dispersal was not outside the Amazonian Basin but within. His model of a Neolithic Revolution held that the Amazonian and Orinocan basins were comprised of a multitude of environmental niches capable of sustaining a higher carrying capacity than previously believed. In short, Lathrap contended that the central Amazon was the "hearth" of the Tropical Forest peoples, based on the interrelatedness between linguistic, archaeological, and ecological lines of evidence. It was proven that soils, especially those of the *terra firme*, were able to sustain growing populations. High protein nuts and fishing could provide enough nutrition to counteract an absence of larger animals. Lathrap also stated that bitter manioc is raised only when an economic surplus is necessary, and that when available is often replaced by maize agriculture; "societies raising bitter manioc tend on the average to have a more extensive and complex network of social interaction" (1970:53). Agriculture and "cultural migration" were viewed as following the dendritic patterns of the river systems, as did the organization of trade networks that were maintained by certain ethnic groups (Lathrap 1973:173).

Roosevelt (1980, 1987, 1991, 2004) uncovered evidence for the presence of complex chiefdom societies, evidenced by monumental earthworks, such as causeways and roads, ditches, and canals, mounded agricultural fields, elaborately decorated ceramics, and large cemeteries. Roosevelt interpreted early radiocarbon dates from these kinds of sites, such as Parmana (near the Orinoco delta), the Apure region of the middle Orinoco, and Marajo Island (Brazil) as evidence for the presence of stratified societies existing in environments previously held to be inhospitable to the development of "complex" hierarchical societies. Although many Amazonian researchers cite numerous problems with the evidence, subsequent work by others (Denevan 1996; Heckenberger et al. 1999, 2001; Lima et al. 2002) have found, in fact, that the *terra preta* (or *terra preta de indio*), or black earth soils are thick, dark anthrosols often containing pottery and other cultural remains, and were fertile soils capable of producing reliable foodstuffs allowing peoples to remain sedentary. People were manipulating and adapting their floodplain landscapes, allowing for a greater carrying capacity and the establishment of larger, permanent settlements.

Spencer (1998) proposed a similar model for the development of social inequality in Venezuela. By ca. 800 to 400 B.C., villages that had been established on natural river levees and were growing due to a shift in agricultural emphasis from manioc to maize. These growing populations placed increasing demands on the limited alluvial levees and floodplains, forcing people to move via the establishment of daughter or satellite villages up and down the Orinoco. Archaeological investigations conducted in the llanos region of western Venezuela has uncovered evidence, primarily from burials and settlement patterns, for the development, by ca. A.D. 500-600, of highly stratified and complex societies, especially in the lower llanos of Barinas (Spencer and Redmond 1992; Spencer 1998; Zucchi 1973; Zucchi et al. 1984). Extensive agricultural efforts, such as drained and mounded fields, were undertaken. Long distance trade networks were established for the acquisition of non-local stone.

Oliver (1989) has suggested a socio-political basis for population and cultural dispersal. His three-stage model is based on three lines of evidence: archaeology, lexicostatistics, and ethnohistorical records. According to Oliver, by ca. 2200 to 1500 B.C., an Early Proto-Maipuran culture had moved into the Middle Orinoco Valley, then spread both up and down the Orinoco River. By ca. 1000 – 500 B.C, the Saladero cultural complex, from which the Caribbean Saladoid culture originated, had developed along the Lower Orinoco floodplain. In short, Oliver contends that the prehistoric populations in Amazonia came nowhere near the carrying capacity of the Basin, and that competition for resources cannot explain population movements nor the development of social inequality.

Heckenberger (2002, 2005) supports Oliver's findings negating the long held belief that competition for land and circumscribed environments spurred the development of the floodplain chiefdoms. Based on linguistic evidence, Heckenberger contends that the center of development for Arawakan language and culture was located between the Upper Amazon and Middle Orinoco in Northwest Amazonia, and that around 3,000 BP, Arawakan groups began to spread up and down the Orinoco, along the Amazon River, and into the Caribbean. He states (2002:110-113) that the regional Arawakan social organization is evidence for social hierarchal ranking system across a "pluralistic, multilingual system," based on the continuity of symbolic structures, the regularity of settlement patterns, a subsistence economy that centered on root-crop agriculture and aquatic resources, and regional patterns of exchange.

Zucchi (2002:221) summarizes the migration and diaspora of northern Maipuran peoples was conducted via "peaceful mechanisms based on an open and inclusive type of sociolinguistic organization," based on a combination of archaeological, ethnographic, myth, and linguistic information. This organization was connected via notions of tolerance, flexibility, negotiation, and aggregation that aided in the "establishment of cross-linguistic ties, transethnic identities, and extended regional alliances and trade networks." These northern Maipuran linguistic groups created their cosmologies through processes of topographic writing, "through which mythical and historical events" are tied to locations on the landscape (Zucchi 2002:218).

SUMMARY

The biotic communities on the Caribbean islands, while similar in many respects to those of lowland Amazonia and the Venezuelan/Colombian coast. These communities, though never stable, began to be severely impacted upon with the arrival of humans to the region, who cut trees to build houses, villages, and canoes and cleared forested areas for gardens and fields. They brought with them non-native animals to the island, including a species of hutia (*Isolobodon portoricensis*), the flightless rail (*Nesotrochis debooyi*), and macaws (Petersen 1997:125), in addition to plants like sapodilla, manioc (yucca), and sweet potatoes. Mounded fields, called *conucos* by early Spanish observers on Hispaniola and Puerto Rico, were constructed in order to foster better crop productivity, especially for manioc.

As the first explorers and settlers traveled up or across the archipelago, locales for the establishment of colonies would have been sought that were similar to those left behind in Guyana/Lower Orinoco and the Venezuelan coast and littoral zone, or environments that included a variety of ecological zones that would have encompassed both a maritime and/or riverine and littoral subsistence strategy and root crop horticulture. Sources for good soils, reliable fresh water, clays for pots and good stone for tools and other objects would have been important draws and factors that aided in determining where people settled down. Of equal importance would be the role of landscape and sacred geography as defined by myth, and the roles of myth in any hierarchical placement of communities on the landscape.

The Arawakan-Saladoid migration into the Caribbean islands can therefore be viewed as one of a people demonstrating heterarchy, with various forms of complex interaction networks and political organization, evident in a hunting-fishing-farming economy, specialized craft production (if only part-time) at the household and village levels, long-distance trade for symbolically valuable objects, and designations of sacred ceremonial space. As these lowland societies differentiated, their changing material culture and belief systems were shared along long-distance interaction and exchange routes that spanned throughout the region and into the Caribbean. Saladoid cultures are here viewed as part of a larger regional cultural sphere, components in a broad Arawakan Ethos of shared and structurally similar belief systems, while later Ostionoid goups, while sharing many of these core beliefs, would have developed unique, local and regional cultures (Santos-Granero 1986, 2002). These Arawakan forms of interaction were brought with the Early Saladoid settlers and transplanted to their new homes. Initially, they would maintain social relations and ties to their homelands for a variety of reasons presented in Chapter 2, but over time these relations would give way to developing regional and local interaction spheres. I examine these potential interaction spheres in the next chapter, using the archaeological sites of St. Croix as a case study. I then apply the tenets of Complex Adaptive Systems and small world networks to analyze the archaeological settlement patterns of the island, based on current knowledge.

CHAPTER 4

ST. CROIX ARCHAEOLOGY AND SETTLEMENT PATTERNS

INTRODUCTION

As introduced in Chapter 3, there are three basic forms of settlement patterns known to have been used throughout lowland Amazonia: single dwellings, circular villages, and linear villages (Boomert 2000a:283). These settlements are most often semi-permanent or long-term occupations located on high bluffs and along the sides of valleys above active river channels, while the floodplain is often used for farming and gardens. Many villages are located along small rivers and perennial streams, above falls or rapids, and at the junctions of tributaries and rivers or where bluffs extend into the river (Denevan 1996:665). These bluff sites are often located on *terra preta* soils. In the Orinoco Valley itself during the Early Saladoid period, the assumed “homeland” of the Saladoid people and culture, people occupied high, forested levees and terraces near rivers, tributaries, and at the mouths of seasonal streams (Boomert 2000a:255).

Throughout Amazonia, history is inscribed on the landscape through mythology, the travels of ancient ancestors, and the emergence of first humans. Sacred places and are often marked with petroglyphs. Villages of high ranking sibs are located at particular places on the landscape, their rank determined by myths of origins, order of emergence, and/or locales where particular mythic (or real) incidents occurred.

As also discussed in the previous chapter, the societies that today comprise Lowland Amazonia developed into their present-day forms through processes of ethnogenesis, in which unique forms of societal organization, belief, myth, and interaction developed over time along unique trajectories shaped by experience and interaction. Many of these trajectories can be traced back to common Proto-Arawak and Northern Maipuran cultures that are believed to have existed somewhere between the Upper Amazon and Middle Orinoco in Northwest Amazonia ca. 2,500 BP. It is this ancient regional culture that gave rise to the Saladoid peoples, who then moved into the West Indies, established settlements, began their own interaction spheres, and thus began developing their own trajectories. By examining these settlement patterns as observed archaeologically, we can begin to infer cultural patterns of socio-political organization, beliefs, and value.

In this chapter, I present models of human settlement, information diffusion, and exchange from cultural geography as idealizations of oversimplified realities. Many models used to study settlement tend to separate and isolate particular components using a systems approach, treating these components as independent variables. I use holistic approach because knowledge and information is not separable from the material, and various components in the cultural system – settlement, interaction, trade and exchange, and cosmology – are interconnected.

I then discuss the current state of knowledge of St. Croix's archaeological heritage, gathered from gray literature, the Virgin Islands territorial site files, and National Park Service's site files. Site location information has been entered into a geographic information system (GIS), and a settlement pattern analysis is presented based on soil, geology, elevation, hydrology, and distance. The potential relations between communities during different time periods were based on proximity to nearby communities using a path distance analysis. This information is used to compare St. Croix's Saladoid period settlement patterns with those reported for lowland Amazonia, in an attempt to discern any possible evidence for a settlement hierarchy across the Crucian landscape. Admittedly, detailed archaeological data regarding site size and settlement arrangement for St. Croix is lacking; an entire house or village has yet to be completely excavated. This makes some forms of local and regional analysis difficult, as many sites have been identified only by the presence of artifacts scattered on the ground surface. For this reason, this study is conducted on an island-wide regional scale, with the recognition that the island itself may not have served as a social boundary identifying group membership.

It is proposed that Saladoid period settlers brought with them practices of village placement and land use, and associated conceptions of landscape. Links between communities and villages followed streams and rivers, and along ridge lines. The settlements themselves were located on terraces and bluffs above these waterways, at junctions with tributaries in inland areas, and at the mouths of waterways along the coast. Other communities developed between clusters of inland sites that acted as connecting nodes or hubs. It is proposed that these hubs were possibly located near resources, such as clays and stone, necessary for the production of utilitarian and prestige goods, or were involved with the transportation of goods throughout the system. Territories or polities of village groups may have been bounded within particular drainage systems; in other words, those villages and farmsteads located within a particular drainage system could constitute a socially related unit. These units would have comprised "localized interaction spheres."

THEORIES OF SETTLEMENT AND SPHERES OF CIRCULATION

Since Willey's initial work (1953) with settlement patterns in the Virú Valley (Peru), many studies have employed a variety of techniques and expanded our understanding of how people migrate to, colonize, and settle new areas, how they interact with new neighbors, established and maintain communication and exchange networks, how social identity is maintained, and how the local environment both influences and is impacted by human settlement. Settlement pattern studies began as a means to describe prehistoric sites in reference to geography and chronology. As defined Willey, settlement patterns are "the way man disposed himself over the landscape…It refers to dwellings, their arrangement, and to the nature and disposition of other buildings pertaining to community life" (Parsons 1972:128).

It is believed that institutions of social interaction are reflected in the ways in which space is organized, and that by studying patterns of settlement, organization of space and distance insight can be gained into the political, social, and ideological spheres of group structure. Geography can be defined through indigenous ecologies and definitions of landscape, which often incorporate or encode conceptions of the sacred. Landscape and dwelling perspectives include these conceptions of historicity, sense of place and ethnic identity, origins and myths, social order, and networks connecting sacred and non-sacred locales and resources.

As noted earlier, tribal societies are typically associated with circular, nucleated villages or are dispersed as small hamlets, or, in riverine environments, may be linear (Carneiro 2002:38). Viewed as autonomous entities, it is often assumed that village location and size demonstrate no hierarchy, where political and/or religious centers of power are supported by smaller hamlets and individual farmsteads. However, as also presented earlier, all societies demonstrate some form of hierarchical ranking, observed in any number of ways: status or prestige goods indicating wealth, status differentiation in burials, or the symbolic placement of structures and villages across the landscape. Among several lowland Amazonian groups, for example, higher-ranking sibs and villages are often located at the mouths of rivers or at ecotones, while lower-ranking communities are at the headwaters; this placement is largely based on myth and sacred geography, discussed previously in Chapter 3.

In the following section, I discuss models for both movement (from cultural and economic geography) and network and social exchange (from economic anthropology and ethnology) in order to establish the basis for the network exchange relations proposed later in the chapter.

Innovation Waves — Hägerstrand Model

The Hägerstrand Model of diffusion describes how objects and knowledge travel through a system via different kinds of waves that emanate from centers of innovation (Haggett 1983:307). These types of patterns include expansion, relocation, contagious, and hierarchic forms of diffusion, each of which develop via several stages. The primary stage begins the diffusion process from centers of innovation, with strong contrasts between the center and remote areas (i.e. new objects appear or develop in the innovation center, and are not present on the frontier). The diffusion stage describes the establishment and development of new centers of innovation in distant areas, with reductions in the formerly strong regional contrasts (the object begins to appear in the frontier at the new centers). In the condensing stages, there is equal acceptance of an item in all areas and all locations regardless of the distance from the center. Finally, the saturation stage is reached when the item is accepted throughout a system with very little regional variation.

The Hägerstrand Model was originally intended as a closed system, and researchers have cited problems with its assumptions, primarily that diffusion is perceived as the means by which innovation and information moves through a system. Innovation is regarded as a rare event. On the other hand, diffusion models are relevant in information-based cultural systems, in which the spread of knowledge and information is regarded as central to the maintenance of cultural and social relations (Blaut 1977:345).

Central Place Theory and Core-Periphery Models

The Christaller Central Place Theory examines how medieval cities, production, and the distribution of products and services were distributed and connected across the landscape. It holds that, in an idealized, uniform environment and closed system, settlements will form a hierarchy comprised of a few, high-ranking centers at the top offering a wide range of services. The majority of villages have decreasing levels of rank and authority, each with progressively fewer services; the greatest number of villages would offer the fewest services. The large centers have tributary or service areas that encompass the lesser-ranked villages. Lower ranked centers are predicted to be located equidistant between two higher-ranking centers. Growth is generated internally from demands for goods.

Related to Central Place Theory is the Friedman Core-Periphery Model, based on Wallerstein's model for World Systems (Hagget 1983). The model divides the world into four main types of regions. The core is the center, with the greatest potential for innovation and growth. Connecting the cores are upward-transition regions, or corridors of development. On the peripheries are resource frontiers or areas of new settlement. New lands are occupied and placed into production. Finally, the downward-transition regions are those where established settlements begin to flounder, due to stagnant economies, low productivity, and total consumption of resources.

The problems with core-periphery theories are the same as for world systems: that the frontier is viewed as a passive actor that receives innovation only from the core, that only the "macroscale" region is the subject of inquiry, that the system is closed, bounded, local, and homogenous and the assumption that frontiers and boundaries are discrete markers visible in the archaeological record (Lightfoot and Martinez 1995:472; Vance 1970:164-166). Innovation and history have no importance, and there is no consideration of the physical realities of landscape. Interregional networks of exchange and interaction are often not regarded as important or relevant, as the primary emphasis is placed on the relationship between the core and its periphery.

Core-periphery models are useful, though, as general analogs for relations between the components of hierarchical systems in which strong ties between important political and religious centers and outliers can be demonstrated. Frontiers, as viewed by Lightfoot and Martinez (1995: 472), are "socially charged places where innovative cultural constructs are created and transformed." Frontiers can be viewed not as a boundary marking distinct territories but as interaction zones that cross-cut social networks. It is on the frontier where innovation, interaction, and change occurs (Lightfoot and Martinez 1995:474).

Vance Mercantile Model

The Mercantile Model is based largely on the Rostow-Taaffe Stages of Growth Model, a four-stage ideal for the economic development of spatial patterns across an archetypal island country (Hagget 1983; Vance 1970). In Stage I, there is a scatter of small ports and trading posts along a coast. Each port has a small inland trading field, but interior settlements are largely unscathed by changes in the coastal ports. Subsistence agriculture is practiced, and only a few of the coastal areas have links to the outside world. In Stage II, new transportation links with the interior settlements develop, and new areas of natural resources are tapped for export. There is differential growth of the coastal centers – some grow, some remain the same, and some diminish in importance. A need for political and/or military control begins to rise. Stage III is marked by the rapid growth of the transportation system around each of the major ports and the emergence of important new centers in the interior at junctions or nodes of transportation. Finally, the transportation links continue to develop, as do major interior markets and centers.

The Mercantile Model includes the following stages (Figure 22). First, explorers and colonists arrive to a new area, returning information back to the homeland about productivity and economic potential. Next, settlers arrive and establish attachment points that maintain contact with a homeland. These initial settlements stand “as a string of originally competitive footholds whose location was predicated entirely on external ties, rather than upon domestic trade and its geography” (Vance 1970:157). Staple food production begins, and exploitation of the local environment is undertaken. Once these initial points of attachment (nodes) are established, new settlements are created in the interior, and internal networks of trade and communication soon develop between them. Depots of staple collection, or storage, are established at some of these newer settlements, and they become nodes in their own right. Finally, central place infilling occurs in the interior, with the initial point of attachment now an important node in the interaction system.

The Mercantile Model was originally developed to respond to deficiencies in Central Place Theory, and describes a model for settlement of new lands tied to a homeland through long distance trade. These new settlements and their developing networks were open, heterogeneous systems subject to external forces and influences, namely local conditions of environment and geography, and the interactions and specializations that grew. When a society colonizes a new area, nodes or innovation centers tend to develop along coasts and act as points of contact between new frontiers and the homeland. Over time, large centers develop in the interior, and eventually the space between the coastal and interior centers or nodes begin to fill with smaller communities. Once this broad, “externally-based system” was established and growing, then a central place-like form of settlement could potentially develop.

Because the economies of ancient northern Lowland Amazonia and the Caribbean were far from Western notions of mercantilism and wholesales, the Mercantile Model can only serve as an analogy for the entry of peoples to a new area while maintaining lines of interaction and communication with a homeland. The analogy is made stronger when it is understood that these settlers are part of a large regional culture that incorporates trade and horticulture, components of the Arawakan Ethos described in Chapter 3.

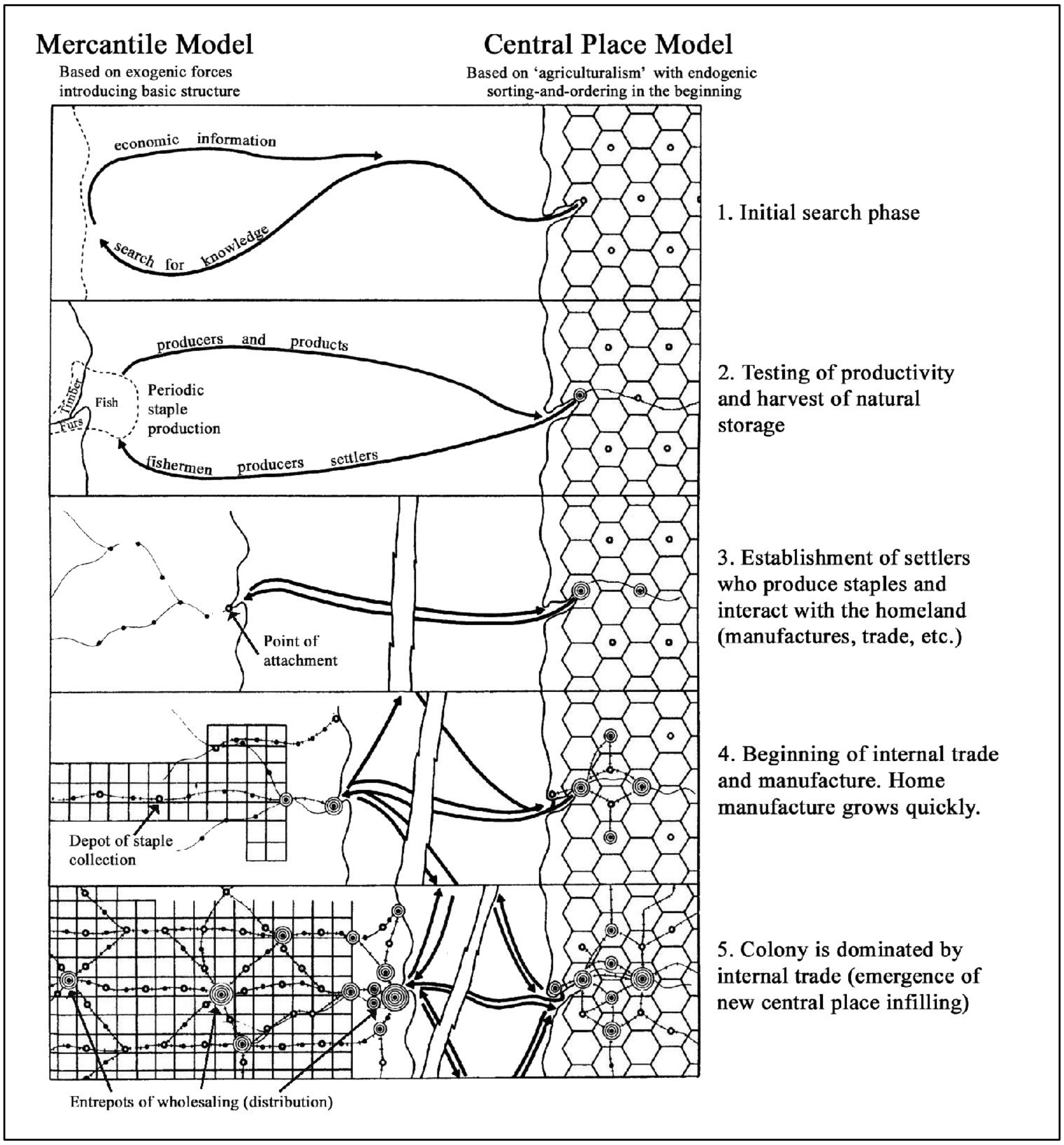


Figure 22. The mercantile model of settlement and diffusion (after Vance 1970:151).

The movement of goods, knowledge, and ideas in the Mercantile Model may appear as linear and/or dendritic patterns on the landscape. Large settlements can develop at key locations along routes that often follow natural corridors, especially in hinterlands or fringes of larger cultural spheres (Hirth 1978, 1984). These settlements can become influential, due to their potential to control the flow of good, availability of resources, and possibly their ritualistic importance and sacred nature, based on history, belief, and myth; they become crossroads between areas of various specialized production, the transfer of technologies, and the communication of knowledge. Dendritic networks are often associated with dispersed populations, difficult means of transportation, and strong external economies. Because of the potentially high costs associated with difficult transportation to remote areas, the location of these gateway settlements is significant. Over time, gateway settlements could grow and compete with other communities. Of several possible outcomes, which include the loss, maintenance, or growth of economic importance, some settlements have the potential to instigate the centralization and coalescence of control of goods, access to materials, the movement of goods, and of symbology. Complex forms of political power can develop as a means to handle competition within a particular region, while interregional trade is de-emphasized in order to maintain local social organizations. The location of the node within a larger system acts to stimulate trade between both local and long-distance networks. In this way, gateway communities can be active agents in the development of hierarchical social networks between areas or villages that were previously heterarchical.

Northern Amazonian Settlement Patterns

Analogies regarding patterns of settlement and dwelling on the prehistoric Caribbean landscape have been drawn with several Amazonian groups, namely the Warao and others not discussed in the previous chapter, like the Bororo, Mẽbengokre or Kayapó (Gê,) and Ye'kuana (Carib) (Heckenberger and Petersen 1999:381; Jackson 1983; Lea 1995:206; Siegel 1996). Among Carib-speaking peoples of the region, there are three recognized forms of settlement: the single communal house, the nucleated village, and the ceremonial center (Riviére 1995:189).

The Warao settlement pattern centers on a circular village plan based on the movements of and alignment with the sun. The design of the house is based on a "divine blueprint" of the house of the Wanadi (universe), or the primordial house. The house itself is erected along the cardinal directions; among the Warao, the house is aligned east to west, while for the Ye'kuana houses are generally aligned north to south. Sunlight enters the structure via a skylight, and throughout the dry season the light travels from the southern wall of the entrance corridor to the northern wall and back; during the rainy season the skylight "turns off" (Wilbert 1993:206).

The single dwelling community (or maloca) is today found throughout the Vaupés region but formerly existed in the Guianas (Boomert 2000a:283). Among the Tukanoan societies of Northwest Amazonia the house, not the plaza, forms the center of the village; instead, the house is surrounded by the plaza (C. Hugh-Jones 1988:43; S. Hugh-Jones 1988:26-30; Jackson 1983:26-36; Reichel-Dolmatoff 1971:104). The house has two entrances, the front for men, the rear for women, and there are paths that lead to canoe launches on the river and out toward the gardens. As stated in the previous chapter, the longhouse comprises the most important social group throughout the region.

The symbolic representation of Amazonian house/maloca structure and the village itself as conceptions of the cosmic order is well documented (Heckenberger 2005; Heckenberger et al. 1999; C. Hugh-Jones 1988; S. Hugh-Jones 1988; Jackson 1983:26-36; Siegel 1996; Versteeg 1989; Wilbert 1993). Among several groups, such as the Tukanoan societies, sacred objects like bone flutes, rattles, and are stored in the shaman's large house or men's communal house, where dances and rituals are often held (S. Hugh-Jones 1988:36). These societies have many shared cultural elements and are also multilingual. Marriage is between those of difference language groups; they demonstrate linguistic exogamy. It has been found that in the past, groups like the Barasana and the Cubeo had forms of sib ranking of specialized roles, which included chiefs, changers/dancers/ warriors, shamans, and servants (Goldman 1981:386-387).

Ring villages and circular plazas settlements have often been viewed as indicative of egalitarian societies. However, in the Upper Xingu region, Xinguano Houses are set in a village based on rank and politics (Heckenberger 2005:258). Major or Cardinal Houses, such as those of major chiefs and important social segments are located on the northern and southern ends of the plaza, while Minor Houses (subordinate leaders and other high-ranking groups) are on the eastern and western ends. Each House is actually a multi-building compound that develops behind the main longhouse of chiefs. Houses are typically comprised of pairs of related families that share economic activities via a basic "householding" pattern. Heads of Houses are chiefly individuals who gain their status through hereditary relations to ancient ancestors, largely based on birth order (Heckenberger 2005:269-270). Houses compete for status based on kin groups centered on high-ranking men and women that share common descent. Titles and names are passed between these high-ranking families.

The most sacred place in the village is the middle of the plaza, which is viewed as the "ancestral core" (Heckenberger 2005:298). This is where the highest ranking people and leaders are buried, while lesser ranked individuals are buried further out around the plaza. The plaza is surrounded by structures (houses), which often have individual dooryard gardens, kitchen gardens, and menstrual huts. Beyond the gardens were refuse middens and latrines. Xinguano villages typically control a five to ten kilometer territory, which includes hamlets and specialized activity areas. Hamlets, comprised of one or a few small houses, are typically occupied during the dry season and are associated with gardens, and these garden hamlets have the potential of turning into new villages.

Spencer notes (1994:375) that the paramount chiefdoms villages (or centers) in Panama were located roughly one day's travel apart, and the chiefdoms in Venezuela encompassed a 40 km territory that included 23 villages spread along a river valley. The entire territory could be covered in a day.

Linear settlements are comprised of communal houses on forested natural levees that tend to follow river and stream channels (Denevan 1996). Models of bluff-floodplain (or bluff-várzea) interaction during prehistoric times have proposed for lowland Amazonia, where there may have been shifts in residence between floodplain levee settlements and interior satellite villages (Denevan 1996:671). Garden plots for each village can be located up to three to four miles away from the village core; because of this distance, there are often field houses located in these gardens, and these field houses will often develop into new villages. The territorial sizes for fishing areas average roughly five km per village (Denevan 1996:673). Boomert (2000a:373) presents data from the Golden Grove site on Tobago in which the subsistence catchment zone was determined to be between one and three kilometers. Additionally, village potters will travel up to six or seven kilometers to obtain clays, but the majority of clays, tempering materials, and finishing products are most often obtained within one kilometer (Arnold 1989:50; Rice 2006:116-118). Potters among the Shipibo-Conibo will travel within a 10 kilometer radius for clays, and up to 250 kilometers for particular colors of paint and resin (Arnold 1989:52-54).

Additionally, there could have been exchange relationships between these communities. Denevan (1996) holds that interior bluffs and valley terraces along active river channels would have been the preferred locales for large, permanent and semi-permanent settlements. Floodplains would have been seasonally available, and been the scene of seasonal farming activities. If this model is transferred to the islands of the West Indies, it is possible that communication and exchange relations existed between more permanent, interior, upland settlements and seasonal coastal plain and coastal villages.

SUMMARY OF ARCHAEOLOGICAL STUDIES OF ST. CROIX

Many of the archaeological excavations and investigations on St. Croix have centered on the Salt River Bay watershed. In all, there have been 20 archaeological field projects conducted just within the current boundaries of Salt River Bay National Historic Site and Ecological Preserve, and all but one occurred prior to 1992, when Salt River was incorporated into the National Park system. The majority of these investigations have been conducted at the Columbus Landing site (12VAm–6) on Salt River Point. A few investigations have also been conducted at Estate Judith's

Fancy (12VAm1–5), located on Hemer's Peninsula across Salt River Bay. In addition to these reported investigations, six sets of collections have been made in the vicinity of the Columbus Landing site by various island residents, amateur archeologists, and people interested in St. Croix's prehistory.

Further up the Salt River watershed, sites such as Glynn (12VAm1–13, 12VAm1–14), Windsor (12VAm1–44, 12VAm1–47), and Concordia (12VAm–56) have provided evidence for the occupation of the entire watershed since the arrival of Saladoid peoples. The majority of the remaining investigations that have occurred on the island have been generated by development, and have been conducted in compliance with both Section 106 of the National Historic Preservation Act (NHPA) of 1966, and the Virgin Islands Antiquities and Cultural Properties Act (1998). What follows is a summary of the major archaeological investigations that have occurred on the island over the past 100 years, in addition to brief descriptions of every known Saladoid to Early Ostionoid period archaeological site on the island (Figure 23).

Unfortunately, many other collections that were made at these sites were conducted by local islanders with a great interest in St. Croix's prehistory, but who had little to no archaeological training. As a consequence, many of these collections were made with without reference to context or provenance, and a lack of scientific control. Photographs and sketches were often not made, and the majority of artifacts that were collected have never been subjected to any form of detailed analysis. Additionally, many of the sites that were "investigated" during the first half of the twentieth century are now destroyed. In some cases, such as at Richmond, Fair Plain, and possibly Glynn, the collections that were made by Folmer Andersen, the Smithsonian Institution, and Gudmond Hatt are the only evidence that they existed. Some sites were recognized by many as large villages, and even after 200 years of colonial agriculture and development, may not have been totally impacted.

Early Surveys

In 1915, Gustave Nordby, a local planter and artifact collector, began to donate his collections of Salt River artifacts to the Danish National Museum, Copenhagen, Denmark. His interest in the island's prehistoric past continued after the United States took control of the Virgin Islands in 1917. Nordby collected artifacts from 22 or 23 sites across the island (Table 4).

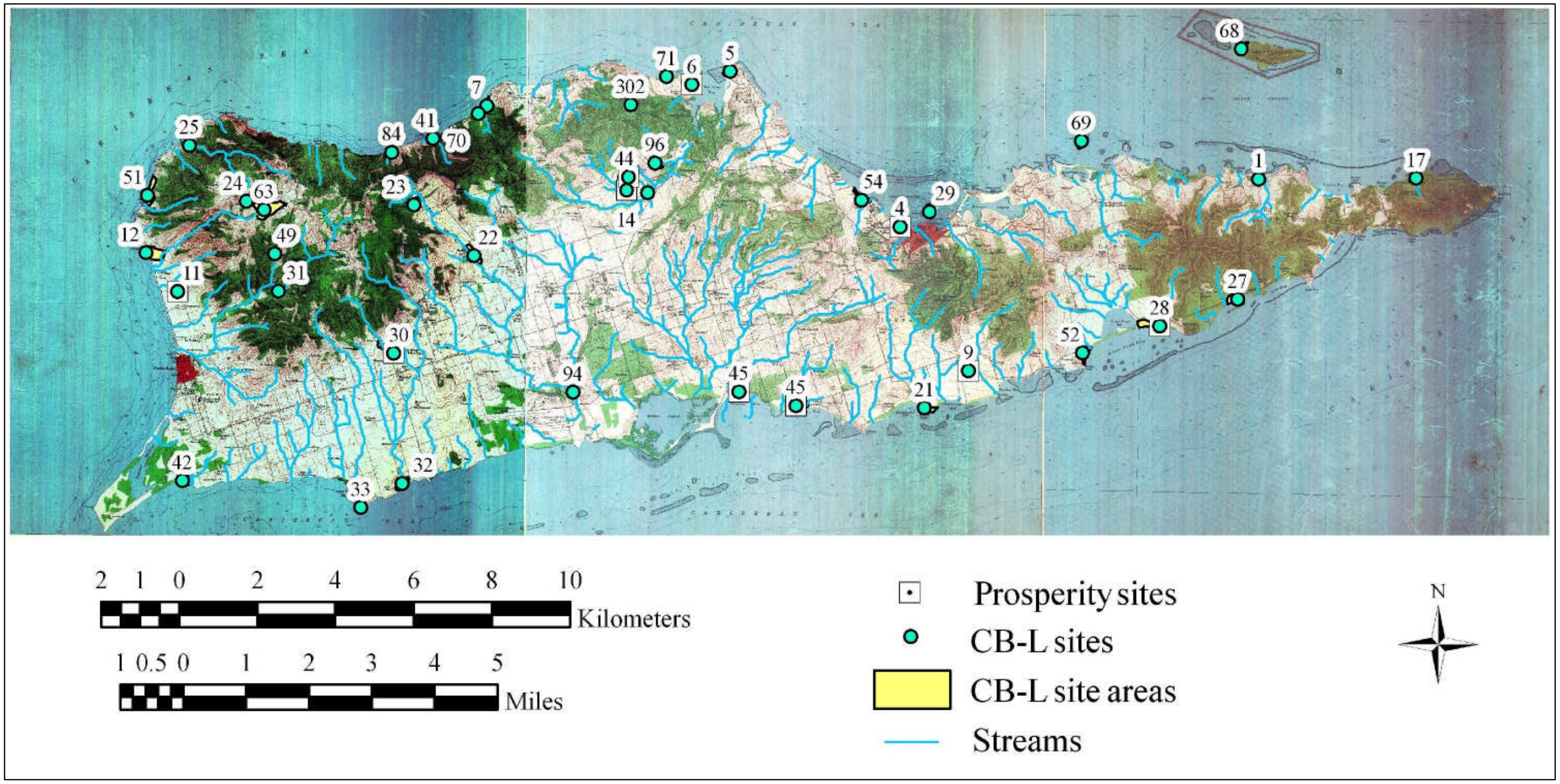


Figure 23. Map of St. Croix archaeological sites discussed in this chapter.

In 1912, Jesse Walter Fewkes visited several prehistoric middens on St. Croix under the auspices of the Smithsonian Institute's Museum of Natural History Bureau of American Ethnography. Told by islanders that the middens at Salt River contained the most archaeological materials of any other site on the island, he went to the site and collected a number of artifacts, namely groundstone petaloid celts, from the ground surface. Based on his observations of a single fragment of an incised stone collar that had been reused as a pestle, Fewkes concluded (1922:166) that the prehistoric peoples of St. Croix were more similar culturally to those of Puerto Rico than the other islands of the Lesser Antilles, like St. Kitts and St. Vincent. He observed no eared or wing-shaped axes (as found in the Lesser Antilles), nor did he report any three-pointer stones or grinding implements.

Table 4. Archaeological sites visited by Gustave Nordby, 1903-1924.

Site Name (Nordby)	*Territorial Site Number (12VAm1-)*
Cotton Valley	1
Cookley (Coakley) Bay	2
Salt River	6
Cane Bay	7
Longford	9
Fair Plain	10
Prosperity	11
Sprat Hall	12 (26)
Glynn	13, 14
Grove Place	15
Plessens	16
Great Pond	28
St. Georges	30
Mt. Pleasant	50
Castle Nugent	62
St. John	77
Fredensborg	78
Williams	79
Adventure	80
Orange Grove	81
Wheel of Fortune	82
Petronella	83
Betty's Hope	161

From 1916 to 1917, Teodoor de Booy of the Museum of the American Indian (then located in New York City) conducted the first systematic archaeological investigations of St. Croix and the Virgin Islands; he concentrated his efforts on "kitchen middens" at both Magens Bay, St. Thomas, and Salt River Bay, St. Croix (de Booy 1919:20; Morse 1989:29). Summarizing his work, de Booy stated (1919:43) that "deposits are found in a semicircle around a small hill on the western bank of Salt River, at the mouth of the inlet, as well as on its crest." His excavation trenches measured roughly 24 feet wide, 12 feet long, and five feet deep, with sloping sides that extended both "north and south from the edge of the sea"(de Booy 1919:43). The exact locations of these trenches are unknown, though de Booy described three general areas of investigation: the kitchen midden itself, an area "near" Salt River, and an area in the "vicinity of Salt River." His only description of the midden is as follows: "A cross section of this ridge shows a diluvial deposit from a foot to two and a half feet in thickness. Directly beneath this was a layer, two and a half feet thick, of the usual charcoal, ashes, potsherds, and stone objects, forming a compact mass with the original soil" (de Booy 1919:43).

Apparently the midden was rich in faunal remains, and de Booy briefly discussed those that were recovered during his excavations. He noted that humans were buried in the midden in similar fashion to the burials encountered at the Magens Bay site. At Magens Bay, nine individuals were interred with pottery vessels; two were in extended position, and the rest were flexed. One of the burials contained three vessels, five had only one vessel each, and one had no vessel. No other artifacts, like axes or amulets, were associated with the burials. Unfortunately, the total number of burials encountered at Salt River is not provided, nor is there any description of them save that several were accompanied with globular-shaped vessels. A total of 706 objects are listed for the de Booy collection in the Smithsonian Institution's database for the National Museum of the American Indian. Among these items were stone beads and a pottery ball, groundstone celts, hammerstones, pestles, adornos, coral and stone pestles, shell trumpets, spindle whorls, three-pointers made of stone, shell, and bone, and boat-shaped bowls, in addition to pottery sherds.

Hatt, 1922 – 1923

From 1922 through 1923, Gudmond Hatt of the Danish National Museum, Copenhagen, conducted an archaeological survey of the prehistoric sites of the Virgin Islands. On St. Thomas, Hatt visited the large and well-known sites located at Magens Bay, Northside Bay, a smaller site at Little Northside Bay (Hull), and a fourth site at Sorgenri Bay. He also visited three small "shell heaps" at Krum Bay and another one at Nisky. On St. John, Hatt visited a total of six sites, including Francis Bay, Cinnamon Bay, Long Bay, and Little Cruz. He also studied the well-known rock carvings at Congo Cay.

Hatt spent the majority of his time on St. Croix, visiting a number of sites across the island. All told, Hatt conducted excavations at 14 sites, though at that time several of these sites were unnamed (Table 5). He was one of the first archeologists to comment on the distribution of archaeological sites across St. Croix, and the significance of location in regards to local environment and soil type.

> Almost all the sites are situated on or near the coast, most of them in the vicinity of well-sheltered bays, reef, or small islands. It would seem that coasts directly opposing the trade-winds and without sheltering reefs were unfavorable places for occupation
>
> [Hatt 1924:30].

Table 5. Archaeological sites visited by Gudmond Hatt, 1924.

Site Name (Hatt)	***Territorial Site Number (12VAm1-)***
Cotton Valley	1
Coakley Bay	2
N of Christiansted lagoon (Beauregard Bay)	3
W of Christiansted (Richmond)	4
E of Salt River (Judith's Fancy)	5
Salt River (Columbus' Landing)	6
Cane Bay	7
Fair Ham	8
Longford	9
Fair Plain	10
Prosperity	11
Sprat Hall	12 (26)
Glynn	13, 14
Grove Place	15
Plessen	16

Island residents directed Hatt to Salt River, where he conducted extensive excavations at Salt River Point and across the bay at Judith's Fancy.

Hatt surveyed six blocks that were to be excavated, lettered A, B, C, E, F, and G, each of which varied in size (Figure 24); Block D was only subjected to a surface collection. The blocks were subdivided into 2 m by 2 m units that were excavated in 25 or 30 cm levels, depending on the block. Unfortunately, few to no artifact counts were provided with the catalog descriptions filed with the Danish National Museum's curated collections, so it is not known if individual entries are indicative of single specimens.

Block A was located at the base of Grieg Hill, in a midden ridge northeast of Fort Salé. The excavation area consisted of 46 units dug in 25 cm levels. Five levels were dug in each unit for a total depth of 130 cm below the ground surface (cmbs); Level 5 being only 10 cm deep (100 to 130 cmbs). A total of 1,137 catalog numbers were assigned to those objects obtained from the Block A excavations, all beginning with the prefix 0.11; numbers 732 through 1000, however, were not used.

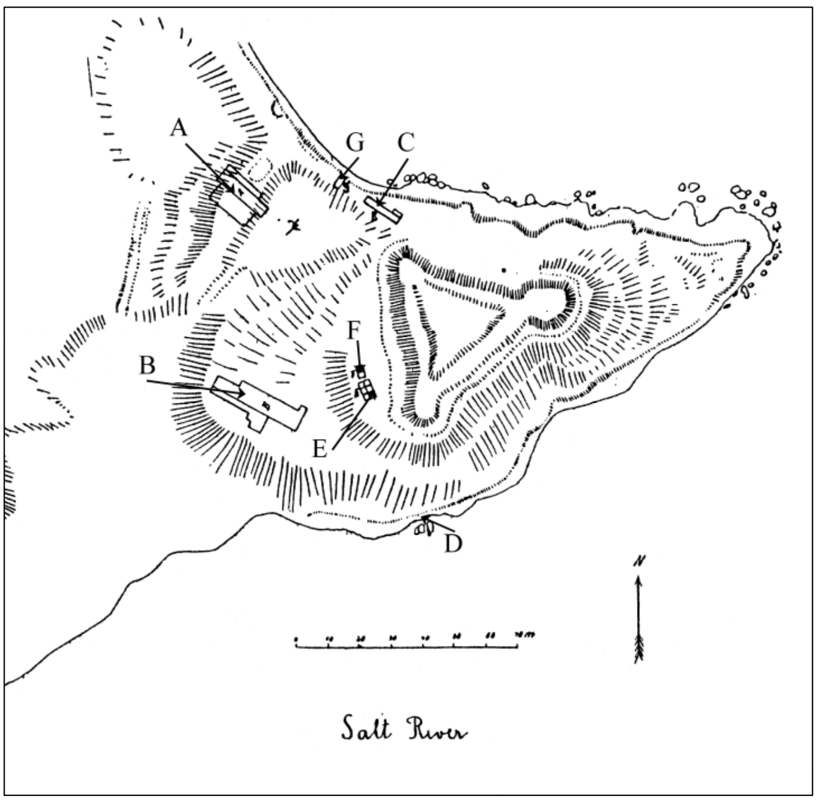


Figure 24. Map of Hatt excavations at Salt River, 1923. X denotes central plaza as identified by Hatt. Courtesy of the Danish National Museum, Copenhagen.

Near the southwestern corner of this block, a row of nine large stone slabs was encountered, that measured roughly eight m long and nearly 0.5 m high. There were two breaks in the row (Hatt 1924:36) (Figure 25). Four of these slabs had carvings on one or two sides, in styles found throughout the Greater Antilles and greatly resembling petroglyphs from lowland Amazonia, Surinam, the Guianas, and the Orinoco basin. Images depicted in these carvings include the “wrapped ancestor,” the “Frog Woman,” and several human faces, both plain and with ornamentation (possibly headdresses). Another petroglyph stood to the northeast of the row that consisted of a face with five vertical lines over it, and a hole bored through just to the right. Hatt (1924:37) proposed that this stone was used for “pious artifice” by a *cacique* to make his/her people believe that the stones “talked;” this assumption was based on the observations of Ferdinand Columbus.

Figure 25. Hatt’s excavations of the ball court at Salt River, with ball court stones in situ, 1923. Courtesy of the Danish National Museum, Copenhagen.

A large midden was located just behind the stone row and extended toward the northwest. Hatt stated (1924:36-37) that the village was located on the hill and the surrounding area and was bordered by an old lagoon. In front of the stone row and north of the hill was a large, flat area that probably served as an open area in the village, or plaza (see the *X* in Figure 24). Scattered throughout the midden was human skeletal material. Four interments appeared to have been intentionally buried, and two of them were located in a platform behind the southwestern end of the stone row (Hatt 1924:37). At least one of the other burials was in a flexed position, lying on the left side. Additionally, the remains of four human children were buried in other midden ridges located both here and across the site (one in Block C, possibly Unit 2). A fifth infant burial was found inside a red-painted bowl in Block E (Unit 1, Level 1), accompanied by a petaloid axe, a carved shell pendant, and a shell disc (Hatt 1924:38; Morse 1997:40-41).

Block B, comprised of 57 units excavated in 30 cm levels, was located along the southern end of the project area. A total of 606 catalog numbers were assigned to the Block B assemblage, beginning with prefix 0.12; numbers 278 through 300 were not used. In the artifact inventories (or *protocols*) provided by the Danish National Museum, numbers 501 through 606 were brief, descriptive lists with little in the way of provenience. Artifact counts and brief descriptions were provided in a separate group of entries for catalog numbers 301 through 412. Notable artifacts included three-pointers of stone and shell, two quartzite rods, possibly bead "preforms" (cat. #s 12.25, 12.143), a carved bone face (cat. # 12.107), an earspool (cat. # 12.1), a partially carved bone swallowing stick (cat. # 12.83) possibly resembling either a dog or a caiman, and ceramic sherds decorated with red painting restricted to the rims and portions of vessel bodies. Boat-shaped bowls and spindle whorls were also recovered.

Block C was located on the northeast corner of the project area, between the northwestern bastion of Fort Salé and the shoreline. The block was comprised of six units, and only one level was excavated, to a presumed depth of 25 to 30 cmbs. A total of 46 catalog numbers with the prefix 0.13 were assigned to the Block C assemblage (numbers 1 through 41, and 100 through 105); numbers 42 through 99 were not used. Perhaps the most significant finds from this block were those associated with a child's burial, located underneath an inverted bowl (cat. # 13.14), which also included a petaloid stone axe (cat. # 13.15) and a partial stone ring (cat. # 13.24). Other objects that were recovered included a small amount of red ochre (cat. # 13.20), spindle whorls (cat. #s 13.9, 13.10, 13.11, 13.25, 13.26), and an additional petaloid axe made of "greenstone" (cat. # 13.35a).

A total of 125 catalog entries, beginning with the prefix 0.14, were assigned to the remaining assemblages: Blocks D, E, F, and G, and various other finds from the ground surface and fill from Blocks A and B (cat. #s 14.25 through 14.125). Block D was comprised of a single find on the ground surface. Blocks E (cat. #s 14.2 through 14.8a) and F (cat. #s 14.9 through 14.12) were located along the eastern edge of the excavation area, just in front of the southwestern corner of Fort Salé. Block E consisted of six units excavated in 30 cm levels. Block F was comprised of only 2 units, also excavated in 30 cm levels. Block G (cat. #s 14.13 through 14.24b), located just northwest of Block C and near the shoreline, consisted of two excavation units with one level each. Artifacts from blocks E and F included three-pointers (cat. #s 14.6, 14.9), petaloid axes, hammerstones (cat. #s 14.4, 14.7, 14.12), and, most notably, the infant burial bowl and various associated objects as described above (cat. # 14.2). Artifacts recovered from Block G included fragments of a stone ring (cat. # 14.13), a petaloid ax (cat. # 14.14), unfinished spindle whorls (cat. #s 14.16, 14.19), and three-pointers (cat. # 14.21), among other items.

Based largely on his work conducted at Salt River, Hatt established the first prehistoric chronology for St. Croix and the Virgin Islands which has, for the most part, remained intact. The chronology was divided into three diachronic components, a pre-ceramic tradition (Krum Bay), and two ceramic traditions, Coral Bay — Longford and Magens Bay — Salt River. The Coral Bay — Longford tradition consisted of ceramic traits found throughout the Lesser and Greater Antilles, such as red-on-white and red-on-black painting, polychrome painting, ZIC wares, inverted "bell-shaped" vessels, and griddles, in addition to three pointer stones and beads and amulets carved of both local and nonlocal stone. The Magens Bay — Salt River tradition consisted of ceramic traits found most notably across the Greater Antilles in midden levels above the Coral Bay — Longford ceramics. Magens Bay — Salt River ceramics included boat-shaped vessels, double bowls, round bowls with inward sloping rims, limited vessel ornamentation, red film or red and black filming, limited vessel painting except for some red around rims and in restricted areas, and *adornos*. Three pointers and stone collar fragments were also typically recovered from these upper levels. Spindle whorls tended to be restricted to upper levels in Blocks B and C, though some were recovered from lower levels (Levels 2 and 4) in Block A. Portions of stone collars (rings) were also recovered, both at Salt River and elsewhere on St. Croix. Hatt surmised that because there were so few collars they were not made locally but were imported from Puerto Rico (Hatt 1924:40).

Hatt correlated the Coral Bay — Longford tradition with a pre-Taíno culture, and he believed that the Magens Bay — Salt River tradition represented Taínan cultural influences from Puerto Rico and Hispaniola.

Andersen, 1920s – 1930s

Folmer Andersen was the manager of the Bethlehem Sugar Factory and other sugar processing plantations across the island from 1916 to 1931. He was also an avid avocational archeologist. In a small publication, *Notes on St. Croix* (1954), Andersen briefly described the geology, geomorphology, and the history of St. Croix, in addition to his own excavations. He conducted excavations at many of the best known prehistoric sites on St. Croix, including Salt River, St. Georges, Fair Plain, Glynn, Windsor, Richmond, Krause (Prosperity) and Sprat Hall, and amassed a collection of some 13,000 artifacts. The collection, now in the possession of the National Park Service, is one of the largest collections of prehistoric Caribbean materials gathered. Unfortunately, Andersen recorded little to no provenance for these objects, and did not describe how they were excavated. Until recently, little analysis has ever been performed on these objects.

In 2006, Rachel Wentz conducted an inventory and analysis of the human skeletal remains housed in the collection; these remains were from the Richmond and Salt River sites (Wentz 2007). Two types of molecular analyses were conducted on the human remains from the CHRI Folmer Andersen Collection. These included radiocarbon dating and stable isotope analyses. In order to make the analysis statistically robust and comparative, additional skeletal material was provided from the Green Cay (an unidentified long bone fragment) and Aklis (a tooth) sites by the U.S. Fish and Wildlife Service, and infant bones from a burial pot from the Salt River site were provided by David Hayes, a local archeologist. Remains were also donated by Jill Wilson on behalf of her mother, Ms. Liz Wilson; these remains were lying in backdirt piles following excavations at the Judith's Fancy site in 1986. Finally, human remains from the Judith's Fancy site were contributed by the National Park Service's Southeast Archeological Center as part of the analysis of excavated materials recovered in 2005 (Hardy 2006, 2007).

The Salt River, Judith's Fancy, Richmond, and Green Cay sites are all located on the windward (north) side of the island, while Aklis is located on the leeward (south) side.

The isotopic analysis was conducted on four tooth samples; no teeth were available from the Green Cay site (Table 6). Testing was conducted by Wentz at the National High Magnetic Field Laboratory in Tallahassee, Florida. Additional testing was conducted by Dr. John Krigbaum at the University of Florida, Gainesville for bone collagen extraction and analysis. The results of the radiometric dating are provided in Table 7; in sum, the majority of dates fall within the range ca. A.D. 650 to 800. These dates correspond to the end of the Saladoid (Coral Bay — Longford) and the beginning of the Ostionoid (Magens Bay — Salt River I) periods.

Table 6. Oxygen and carbon isotope analysis results, Andersen Collection and other contributions (Wentz 2007).

Sample Number	*Site*	*δ^{13}C PDB*	*δ^{13}C std dev.*	*δ^{18}O PDB*	*δ^{18}O std dev.*
6(1)	Richmond	-11.29	0.05	-1.28	0.02
6(2)	Richmond	-11.37	0.04	-1.32	0.07
9	Aklis	-9.95	0.05	-2.09	0.07
10	Judith's Fancy	-11.12	0.03	-1.87	0.10
11	Salt River	-12.15	0.04	-1.40	0.07

Table 7. Radiometric dates obtained from Andersen Collection and other contributions (Wentz 2007).

Lab. No.	***Site***	***Material***	***Conventional Age***	***Measured Radiocarbon Age***	***13C/13C Ratio***	***2 Sig Cal***
217564	Richmond	Human skeletal sample (bone collagen, collagen extraction with alkali). AMS-Standard Delivery	1380+/-40 BP	1280+/-40 BP	-18.7 o/oo 15N/14N = +11.8 o/oo	Cal AD 620 to 690 (Cal BP 1330 to 1260). Intercept = Cal AD 660 (Cal BP 1290).
217565	Salt River	Human skeletal sample (bone collagen, collagen extraction with alkali). AMS Standard Delivery	1190+/-40 BP	1050+/-40 BP	-16.3 o/oo 15N/14N = +15.0 o/oo	Cal AD 720 to 740 (Cal BP 1230 to 1210). Intercept = Cal AD 870 (Cal BP 1080).
217566	Green Cay	Human skeletal sample (bone collagen, collagen extraction with alkali). AMS-Standard Delivery	1320+/-40 BP	1170+/-40 BP	-15.6 o/oo 15N/14N = +12.1 o/oo	Cal AD 650 to 780 (Cal BP 1300 to 1170). Intercept = Cal AD 680 (Cal BP 1270).
217567	Aklis	Human skeletal sample (bone collagen, collagen extraction with alkali). AMS-Standard Delivery	1280+/-40 BP	1120+/-40 BP	-15.3 o/oo 15N/14N = +12.8 o/oo	Cal AD 660 to 810 (Cal BP 1280 to 1140); Cal AD 840 to 860 (Cal BP 1110 to 1100). Intercept = Cal AD 710 (Cal BP 1240)
217568	Judith's Fancy	Human skeletal sample (bone collagen, collagen extraction with alkali). AMS-Standard Delivery	1330+/-40 BP	1150+/-40 BP	-13.8 o/oo 15N/14N = +12.3 o/oo	Cal AD 650 to 770 (Cal BP 1300 to 1180). Intercept = Cal AD 680 (Cal BP 1270).

Stable isotope analysis of carbon revealed that people living at all four sites had diets comprised primarily of C3 plants (including manioc, beans, and peppers). Those sites located on the northern (windward) side of the island had greater negative values when compared to Aklis, located on the southern (leeward) side of the island. Plants that were used by people at the Aklis site were enriched with C3 likely due to lower amounts of rainfall compared to the northern side, resulting in higher C3 values. Surprisingly, this indicates that the diet of the earliest Crucians was more dependent on C3 plants than marine resources. The oxygen values were within expected ranges for the geographic location, again reflecting differences in rainfall for the windward and leeward sides of the island; rainfall on the leeward side was more depleted of O18, as indicated by the increased negative $\delta 18O$ value at the Aklis site.

These isotopic values reflect differences in diet based largely on geographic variations in rainfall across the island. Additional insight could be gained by analyzing levels of nitrogen via bone collagen extraction. Unfortunately, population profiles could not be obtained because of the lace of provenience information and because only single individuals representing each site could be tested. The results from this metric and molecular analysis will form the bases for future research on ancient Crucian populations.

Krieger, 1937

In 1937, Herbert Krieger of the Smithsonian Institute's Museum of Natural History conducted excavations at several sites on St. Croix, including Salt River and Aklis. These investigations were a part of ongoing studies undertaken by the Smithsonian, beginning in 1928, of prehistoric cultures of the Caribbean. In his report Krieger only devoted two paragraphs to the St. Croix excavations, the majority of which describe Salt River.

Though in his notes he described in some detail the kinds of artifacts that were recovered, like shell dishes, spoons, celts (what he termed "gouges"), worked shell pendants, bracelets, figurines, groundstone axes, and some pottery, Krieger did not describe from which sites they were found. He did mention some interesting observations, including that perforated earthenware discs were only encountered in large numbers on Crucian archaeological sites and nowhere else "in the former habitation sites of the island Arawak" (Notes, Examination and Report, Sheet #5, 1937).

Objects excavated from the Aklis site include a carved bone effigy and several pieces of carved bone, a fragment of a bone flute, polished celts, and white on red wares with orange banding (Prosperity style vessels).

Peabody Museum (Yale University) and the St. Croix Museum, 1951

In 1951, an island-wide archaeological survey of St. Croix was conducted by Yale in concert with the St. Croix Museum (Vescelius 1952). Thirty-six archaeological sites known to exist by island residents were selected for investigation, and were subjected to generalized site inspection and surface collection. Twelve of these sites were then chosen for excavation, with test pits that measured five feet square, dug in six-inch levels. Parallel trenches were excavated at most of these sites that measured 10 feet long and five feet wide. The sites chosen for excavation were: Cotton Garden (Territorial Site # 12VAm1–17), Cotton Grove (12VAm1–27), Cotton Valley (12VAm1–1, limited), Fountain (12VAm1–23), Great Pond (12VAm1–28), Judith's Fancy (12VAm1–5, limited), Jolly Hill (12VAm1–31), Manchenil (12VAm1–40), Milord Point (12VAm1–52), Richmond (12VAm1–4), River (12VAm1–22), and Salt River (12VAm1–6). However, only 4 of these sites were chosen as analytical units in the final report (Milord Point, Richmond, River, and Salt River). A total of 28,447 historic and prehistoric artifacts were recovered. In the final report, Vescelius (1952) only discussed decorated prehistoric ceramics; there was no analysis or discussion of shell, stone, or bone artifacts, or of undecorated ceramic wares.

Based on his analysis of topography, surface features, and soils, Vescelius estimated that only 28 percent of the total island land area contained 63 percent of all prehistoric archaeological sites known at that time, and that this land was comprised of alluvium. Thirty percent of the alluvial sites were located in the northwest mountainous areas of the island; the majority of these sites arose during the Late Saladoid period, and continued to be occupied throughout the Ostionoid period. Nineteen percent of all sites were located on rocky shores, followed by highlands and valleys (10 percent), beaches (five percent), and marl areas (three percent). All of the larger communities were located either within the alluvial zones or at the boundary between alluvial fans and mountainous or hill regions (or in ecotones).

Forty-six percent of all archaeological sites known in 1951 were located in the northwestern mountainous region, followed by the eastern portion of the island (21 percent), isthmus (14 percent), and the southwestern coastal plain (12 percent). One-third of these sites were defined as inland communities, or over one mile from the shore.

Vescelius applied the Puerto Rico chronology current at the time to St. Croix. Initially, he found that many of the sites (n= nine) were affiliated with Cuevas culture, which at that time was equated with the Early Saladoid period (equivalent with today's Hacienda Grande from Puerto Rico). He noted that there was some evidence for the either the transport of goods or at least cultural influences, from eastern Hispaniola and both eastern and western Puerto Rico, as well as Trinidad, evidenced by a few Palo Seco style sherds.

Virgin Islands Office of Archaeology (OAS), 1981

From 1980 to 1983, the Virgin Islands Office of Archaeological Services (today the Division for Archaeology and Historic Preservation, Department of Planning and Natural Resources), conducted an island-wide archaeological survey in order to evaluate the conditions of each site and to verify their existence and location (Johnston and Lundberg 1985). All sites listed in the territorial archaeological site files were visited, and attempts were made to relocate prehistoric deposits rumored to exist but never substantiated. Information on environmental setting and elevation, soil type, site size, and cultural affiliation was recorded. Additionally, when sites could not be verified or were found to be erroneously attributed as prehistoric sites (i.e. historic slave or Afro-Crucian sites), detailed descriptions were provided.

The survey confirmed many of the long-held beliefs regarding patterns of settlement across the island. In short, sites were found to be located both on the shore and in alluvial and inland valleys, in addition to slopes, ridges and hilltops, rocky peninsulas, and cays. It was found that sites were located in places not necessarily based on their proximity to fresh water and good soil. Johnston and Lundberg proposed that the people in these villages were probably relying on each other to obtain resources not readily available, and that villages were established on the basis of specialized exploitation of particular resources.

Morse 1989, 2004

Birgit Faber Morse conducted a settlement pattern analysis for both Saladoid (1989) and Ostionoid (2004) period sites, based largely on the results of the 1951 Yale University and St. Croix Museum survey discussed above. At that time, there were ten known and documented Early Ceramic sites on the island (Vescelius 1952, Morse 1989). Eight of these ten settlements are located within one km of the coast, while the other two are located three to four km inland along river valleys. Four of the Saladoid period sites were attributable to the Prosperity period (Period IIa): Prosperity, Richmond, Salt River, and St. Georges. The remaining six sites were first occupied during the Coral Bay — Longford period: Aklis, Fairham (Fareham), Glynn, Great Pond, Longford, and Sprat Hall. Morse noted (2004:185) that the Ostionoid period is characterized by a decrease in the number of inland and coastal plain sites (located within 1km of the shore) during Periods IIIb and IV (Magens Bay — Salt River II and III), while the number of coastal sites remained roughly the same.

SALADOID SITE DESCRIPTIONS

The following is a description of archaeological sites that are described as dating to both the Early and Late Saladoid periods, largely based on ceramic traits and, when available, radiometric dating. The majority of this information was culled from the Territorial site files, in addition to available publications, contract reports, and discussions with archaeological project leaders.

Aklis (12VAm1–42)

The Aklis site is located at Sandy Point National Wildlife Refuge, on the southwest tip of St Croix. The site has been excavated several times since the 1920s and 1930s. Unfortunately, the majority of these early investigations and collections were uncontrolled; provenience information was not collected, maps were not drawn, and photographs were not taken. These collections are now housed in several institutions around the United States, included the Smithsonian's Museum of Natural History (excavations by H. Krieger) and the Yale Peabody Museum. Finally, Panamerican Consultants, Inc. (PCI) conducted systematic controlled archaeological excavations in 1994.

Based on ceramic assemblages, the site was believed to have been occupied from the Coral Bay — Longford to the Magens Bay — Salt River II periods (ca. A.D. 400 – 1200) (based on comparisons of ceramics from Puerto Rico). Four radiocarbon dates were obtained during the PCI investigations, ranging from ca. A.D. 795 to 1800. The ceramics recovered during this investigation point to an occupation during the Coral Bay — Longford through Magens Bay — Salt River II periods. The study of the Krieger collection of Aklis materials housed at the Smithsonian Institution's Museum of Natural History revealed that Prosperity style ceramics were also present at the site; this will be discussed in greater detail in the following chapter.

Finally, isotopic and radiometric testing was conducted by Rachel Wentz on remains collected in 1989 and analyzed by Glen Doran, as part of a comparative analysis of human remains in the Andersen Collection (Doran 1990) (see description above). The radiometric testing provided dates of 1,120 ±40 BP (ca. A.D. 830), and a conventional age of 1,280 ±BP.

Butler Bay (12VAm1–51)

The Butler Bay site is a large settlement located on an alluvial plain on the west coast of St. Croix. It measures roughly 300 meters running north to south and 100 meters inland from the shore. The site was first visited by Vescelius in 1951, when he attributed it to the Cuevas period (Saladoid period), and again by Figueredo in 1972. During the 1981 survey, the site was dated to ca. A.D. 800 to 1100 on the basis of ceramic stylistic attributes, placing it in the Magens Bay — Salt River I and II phases. There are no known radiometric dates for the site, and burials have not been reported. Shell middens have been encountered, and faunal remains, stone celts, and coral three-pointers have been recovered from the site.

Cane Bay (12VAm1–7)

Cane Bay is located on the north shore, west of Salt River. The site was visited by Nordby, Hatt described it in 1924, and Vescelius and his team conducted a surface survey of the site in 1951. The site is large, covering some 15 acres of sloping coastal plain, and consists of a scattered midden of shell, ceramics, and faunal remains.

In 1987 and 1988, MAAR Associates conducted archaeological testing at the site. A hearth was also encountered, and charcoal samples were radiocarbon dated to 1,380 ± 90 BP (ca. A.D. 570). Human remains were encountered; one male, between the ages of 27 and 34 and would have stood about five feet seven inched tall, was semi-articulated with his head facing west, and several disarticulated remains, one adult female, a child, and an older adult, were encountered in a midden. These remains demonstrate evidence of burning, and analysis of the remains by Ubelaker revealed (Ubelaker et al. 1988:5) that the skin was likely removed from the body and the bones were allowed to dry prior to burning. The long bones of the single, semi-articulated male had also been staked and bundled.

Finally, two turquoise beads were recovered in close proximity to the multiple, disarticulated midden remains. Based on ceramic attributes, the site was dated to between ca. A.D. 500 and 1200, occupied from the Late Saladoid through the Ostionoid periods.

Clairmont Hill (12VAm1–302)

Clairmont Hill is a small, shallow site located on a mountain top above Salt River Bay covering less than an acre. It is part of the Salt River Archaeological District, comprised of the Glynn, Windsor, Concordia, and Salt River sites. Figueredo tentatively dated the site to ca. A.D.

200 – 1100, based on ceramic attributes. However, the territorial site form does not provide any description of the ceramics. During the 1981 OAS survey, it was attributed to the Late Saladoid and Elendoid transitional period (Coral Bay — Longford to Magens Bay — Salt River I phases). It is believed that the majority of this site was destroyed due to development. *Stombus* sp. and codakia shells have been recovered, in addition to a pottery bowl with legs. No other descriptions were provided.

Cotton Garden (Cramer Park; 12VAm1–17)

The Cotton Garden site is a Late Saladoid to Elenoid transitional period site located on the northeastern shore of the island. It was discovered during the construction of a public park, and runs for nearly 200 meters from north to south and 400 meters east to west, though its exact boundaries are not known. It was first identified by Gudmond Hatt in 1924, and again by Vescelius in 1951. Ostiones, Santa Elena, Boca Chica, and Esperanza styles (Coral Bay — Longford through Magens Bay — Salt River III) ceramics have all been recovered here. There are no known radiometric dates, and burials are not known to exist.

Cotton Grove (Robin's Bay; 12VAm1–27)

The Cotton Grove site is a settlement that runs roughly 700 meters along the southern (lee) shore of St. Croix, and comes inland about 100 meters. The site was first identified by Vescelius in 1951, where he attributed it to the Late Saladoid and Early Ostionoid periods (Cuevas, Ostiones, and Santa Elena, or Coral Bay — Longford through Magens Bay — Salt River I and possibly II). Vescelius noted (1952) a large number of griddle sherds at the northeastern end of the site, in addition to stone celts, and *Strombus* sp. and codakia shells.

In 1988, the site was tested by Ted Payne of MAAR Associates (Payne 1993). Two test excavation units produced ceramics attributed to the Prosperity through Magens Bay — Salt River II periods. Human long bones were also recovered. Radiometric dating of charcoal proved problematic in that they returned dates of 480 ±150 BP, or ca A.D. 1470, too late for these ceramic types.

Recent testing has revealed that the site is much smaller than originally believed (Carlos Solis 2007, personal communication). According to Solis, the site consists of a central area devoid of artifacts surrounded by midden. Analysis of the results of this investigation are, at the time of this writing, still ongoing.

Cotton Valley (12VAm1–1)

Cotton Valley is located on St. Croix's northern shore, east of Christiansted, at the base of an alluvial fan and along either side of Cotton Valley gut. Nearly every archaeologist who has worked on St. Croix has visited this site, including Nordby (1920s), Hatt (1924), Vescelius (1952, 1975), and Figueredo (1973). The site covers roughly one acre, and has been dated to ca. A.D. 500 to 1300 (Coral Bay — Longford through Magens Bay — Salt River III phases) based on ceramic styles. The settlement pattern is described as similar to other north shore sites; that is, shell midden surrounding a cleared central area or plaza on an alluvial fan within one kilometer of the shore. Several burials were noted to have been encountered, but there are no descriptions of their placement, orientation, or of any analysis conducted on the remains. There are no known radiometric dates. Today, the site is located underneath a fire station, but there is a possibility that portions of the settlement remain undisturbed.

Davis Bay (12VAm1–84) and Prosperity 2 (12VAm1–41)

Both the Davis Bay and Prosperity 2 sites are located on the north shore of St. Croix, west of Salt River Bay and Cane Bay, roughly 1,100 meters apart. Both of sites are remarkable in their absence of shell. They have both been dated to the Saladoid and Elenoid periods, ca. A.D. 300 – 700 (Davis Bay) and ca. A.D. 300 – 1100 (Prosperity 2), based on ceramic stylistic attributes. The Davis Bay site covers about five acres, while Prosperity 2 encompasses nearly three acres. There are no known radiometric dates, and no known burials from either of these sites.

Enfield Green (12VAm1–32)

The Enfield Green site is located at the mouth of Mint Gut, on the southern side of St. Croix. The site was reported by Vescelius in 1951, but was not visited until 1982 as part of the OAS survey. In 1982, the survey team found that a road bisects the site, and many conch shells (*Strombus* sp.) were eroding out of the exposed road cut. It is not known if the actual site is located on the nearby higher bluff. The site is estimated to be roughly 5,500 square meters in size (1.4 acres), and it could be related to the St. Georges site, located further upstream. The team recommended further testing, which has not been conducted. There are no known radiometric dates for the site.

Fountain (12VAm1–23)

Fountain was first described by Vescelius (1952) as a small site located on the bank of a gut just northeast of a pond (illustrated on the 1958 quad map). The site is located two kilometers northwest (or nearly one and one-half miles upstream) of the River site. The site has been attributed to the Late Saladoid period (Coral Bay — Longford through Magens Bay — Salt River I phases), based on ceramic attributes. When the OAS survey team attempted to relocate the Fountain site in 1981, they found that the adjacent gut had been dammed and rerouted, and a golf course now stood on the area. The majority of the site is likely destroyed, though future testing could locate intact, undisturbed areas. There are no known radiometric dates for the site, nor are there reports of human remains.

Gentle Winds (12VAm1–71)

Located just over 700 m west of the Salt River site, Gentle Winds is a Late Saladoid through Early Ostionoid-period occupation that was likely related to its neighbor to the east. The site was first visited by the OAS in 1975, and was revisted during their 1981 island-wide survey. It was proposed that this site served as an agricultural production or support center for the Salt River settlement, and a conch midden was noted toward the east end of the bay. On the hilltops above the site are a series of sites, which were likely lookouts. Shell, a stone axe, and Coral Bay — Longford through Magens Bay — Salt River I pottery has been recovered. There are no radiometric dates for the site, and to date no burials have been reported.

Glynn (12VAm1–13, 12VAm1–14) and Windsor (12VAm1–44, 12VAm1–47)

The Glynn site, formerly known separately as Glynn 1 (12VAm1–13) and Glynn 2 (12VAm1–14) is located north of Concordia Gut and northeast of Lebanon Gut (southwest of the Salt River site). Nearby is the Windsor site, located near the Windsor Great House. These sites are attributed to the Prosperity through Coral Bay — Longford and Magens Bay — Salt River I periods, based on ceramic attributes and decoration. Vescelius described the village as part of the first migration wave to St. Croix. There are likely several additional villages in this area.

The site has been investigated by Gustav Norbdy, Gudmond Hatt, Folmer Andersen, and Vescelius (1952). Andersen (1954:28) described the site as “a large settlement with burials in four fields.” Gudmond Hatt noted that many shell carvings were recovered here. The site was reinspected in 1982, as part of an island-wide survey of known archaeological sites, and again in

1983 as part of the Mon Bijou flood control project (Lundberg and Robinson 1984). As a result of this last investigation the site's boundaries were expanded west toward Lebanon Gut. The boundary of Glynn 1 was expanded to include Glynn 2, and it was hypothesized that Windsor I was most likely a historic site with Afro-Crucian wares (colonowares). Bivalve shells recovered from test excavation pits were identified as *Anomalocardia brasiliana* and *Crassostrea rhizophorae* (Carib pointed-venus and mangrove oyster, respectively). The prehistoric components of the Vescelius and Andersen Collections from Windsor are possibly from Glynn 1. There are no known radiocarbon dates from these sites.

Today, both of these sites comprise the Upper Salt River Archaeological District, which is listed on the National Register of Historic Places. Plowing and development have destroyed some of these sites, and what remains is threatened by further development. However, these sites may are potentially some of the earliest on the island, and may yet provide valuable information on the lives of the island's first settlers.

Great Pond (12VAm1–28)

Just east of Great Pond, on St. Croix's south coast, is the Great Pond site. The site is long and narrow, covering roughly 17.5 acres (70,818 square feet), and is located near fringing mangroves, low sand ridges, and a barrier coral reef. The site has been visited by Nordby, Andedrsen, and Vescelius (1951), but not by Hatt or Krieger, and is described as consisting of series of shallow deposit sheet midden, linear shell middens and mounds. It is considered to have been occupied from the Late Saladoid through early Ostionoid-periods based on ceramic attributes (ca. A.D. 300 – 700 and 700 – 900, respectively). It is not known if Great Pond was one large village, a series of small hamlets, or is representative of several successive occupations, possibly as a result of seasonal use during the summer dry season (June through July) when sea turtles are nesting. There are no known radiometric dates from the site.

The terrace where the site sits is actively eroding, but has not been subjected to much development. The area is similar in many respects to the location of the Halfpenny and Manchenil sites, and is rich in clays exposed in the nearby gut.

Halfpenny (12VAm1–21) and Manchenil Bay (12VAm1–40)

The Halfpenny and Manchenil sites are a pair of sites located on the south-central shore of the island, on either side of Granard Gut. Together, they encompass nearly 25 acres, and though originally believed to be two separate sites, it is now felt that they indeed represent one large, multicomponent occupation. A salt pond used to be located nearby prior to development efforts in the 1950s.

Halfpenny is generally regarded as the earlier of the two, dating from the Late Saladoid and Early Ostionoid periods (ca. A.D. 500 – 900) to the Late Ostionoid (ca. A.D. 1100 – 1500), and consists of shallow shell middens. The site has been visited by the OAS in 1982, and limited excavations were undertaken in 1987 by MAAR Associates.

The neighboring Manchenil site (ca. A.D. 1100 – 1500) most likely forms a site pair with Halfpenny, growing as a result of either increasing populations or a return to the area after a possible brief absence. The Manchenil site has received more archaeological attention, and was excavated by Vescelius in 1951.

Today, the Halfpenny site as been disturbed by residential development while Manchenil remains largely undisturbed except for beach erosion. There are no known radiometric dates from either site.

Ham's Bay (12VAm1–25)

The Ham's Bay site is located on the northwest shore of the island, and near the mouth of a watershed that drains the Caledonia Valley area. The site has been visited by Vescelius (1952) and Figueredo (early 1970s), but has not been subjected to systematic testing. Nearby archaeological sites have been dated to the Late Saldoid and Early Ostionoid transitional period based on ceramic attributes. The only artifacts reported to have been collected are a handful of undecorated pottery sherds. While there is the possibility that this site is actually historic, and the sherds are actually Afro-Crucian wares (colonowares), because of its location and proximity to nearby sites that are contemporary to each other, it is reasonable to assume that the location was occupied during prehistoric times, as well. Additionally, because of the potential for heavy rainfall to redeposit materials from further upstream, there is also the possibility that the actual site itself is located slightly inland, and the sherd recovered from near the shore represent alluvial wash. Additional research is necessary.

Jolly Hill (12VAm1–31)

The Jolly Hill site is a large inland, mountainous village located in a small valley near fertile soils and reliable fresh water. The site covered over two acres (and is quite possibly as large as 10 acres), and is described as being occupied during the Late Saladoid and Early Ostionoid periods (Coral Bay — Longford through Magens Bay — Salt River II phases), based on pottery decorative attributes. No one has conducted systematic excavations at this site, though numerous local artifact collectors have made repeated visits. While Vescelius collected pottery during the 1951 survey he did not define the site's boundaries. As described by the former owners (himself an avid artifact collector), the site consists of a thin scatter of artifacts on the hilltops and slopes that becomes a thick midden next to the nearby gut.

The site has produced interesting finds, including polished stone celts, carnelian and "jadeite" beads, a conch shell carved into a frog, and another shell carved into a hummingbird. There are also remains of marine shell, including *Strombus* sp. and *Nerite* sp., indicating either interactions with coastal communities or possibly movement on this community between coastal and inland villages.

Judith's Fancy (12VAm1–5)

The Judith's Fancy site is located on Hemer's Peninsula on the east side of Salt River Bay, across the bay from the Salt River site. The prehistoric site on Hemer's Peninsula was first identified by Gudmond Hatt while excavating at Salt River Point in 1923. Though there is little known from this early survey, he did conduct limited excavations and plotted its location. In 1951, the site was revisited by Gary Vescelius during the St. Croix Archeological Survey, conducted jointly by the Yale Peabody Museum of Natural History and the St. Croix Museum (Vescelius 1952). Vescelius, thinking he had relocated Hatt's Site 5, plotted the site in a slightly different location and labeled it Number 5 in the Virgin Islands site files. He categorized Judith's Fancy as a single component site associated with his Period IIIa (ca. A.D. 650 – 950), the beginning of the Ostionoid period.

Based on excavations conducted in 1986, Alfredo Figueredo ascertained that because it was open and exposed to the sea and not well protected from northeasterly winds, the Judith's Fancy site was probably not a farming village, but "the location of undisclosed special activities" (Figueredo and Winter 1986:11). It was proposed that this "activity area," possibly specialized ritual activities, would have been associated with the inhabitants of the Columbus Landing site across the bay.

Contrary to this hypothesis, Joe Joseph of New South and Associates (1989) found evidence for extensive middens just north of Figueredo's testing area. He concluded, however, that the distribution of ceramics recovered during shovel tests were not indicative of the typical concentric-ring pattern of Saladoid and early Ostionoid village sites found throughout the Caribbean. Instead, Joseph believed that the site consisted of several individual habitations, each with their own specific midden.

A 1988 survey conducted by the Interagency Archeological Services Division (IASD) of the National Park Service (IASD 1989) resulted in the radiometric dating of human skeletal material that was recovered during Figueredo's 1986 investigations. These remains, those of an adult male between the ages of 25 and 45, produced a raw radiocarbon date of 1,150 BP ±70. By using calibration tables, the real time scale was determined to have been between A.D. 665 and 1015, placing the age of the skeleton firmly within the Magens Bay — Salt River I or II periods (ca. A.D. 600 – 900, ca. A.D. 900 – 1200).

A feasibility study was funded by the National Park Service to identify suitable locations for the placement of a marine research and education center in the vicinity of Salt River Bay (Hardy 2007). While four specific areas or combinations of areas were proposed for the center's location, only two of them were located within the boundary of Salt River Bay National Historical Park and Ecological Preserve (SARI). The National Park Service's archaeological investigations were prioritized to address areas with the greatest potential to house a proposed marine research and education center, and were focused on identifying and delineating any archeological resources within the core areas of Hemer's Peninsula and along the eastern shore of Salt River Bay.

The team excavated a total of 56 shovel tests in two parallel transects, following the shoreline in areas that were assumed, based on the vegetation, to be lands undisturbed or created during dredging activities in the 1960s (Hardy 2007). A possible sheet shell midden was encountered in seven of the shovel tests, in close proximity to Vescelius' Site 5. Stratigraphically, the lower zones of two of the tests consisted of dark brown to black loamy clayey muck with small weathered shells, typically indicative of old or relic mangroves. While there is the possibility that these soils and shell were actually the remains of an ancient mangrove, this cannot be substantiated without additional testing.

The team then excavated the Judith's Fancy prehistoric site (12VAm1–5). All of Figueredo's excavation units from his 1986 investigation were relocated, identified, cleaned of debris, and photographed. Three of these units — U15, V15, and P18 — were selected for profiling, and the slumped fill covering the walls and floors was removed. Two of these units were chosen for cleaning and profiling because they were known to have contained human burials (three in U15 and one in P18), while the third, V15, was selected in order to illustrate stratigraphy from a non-burial unit. Two of the units that were cleaned and profiled, V15 and P18, were selected for expansion; these expansions were placed in neighboring balks.

Additionally, two new excavation units, measuring two by two m, were established following Figueredo's original grid; these units were designated R12 and Z29. Unit R12 was placed within the limits of Figueredo's original grid, while Z29 was established by expanding the west line of the grid 35 meters to the south and 10 meters east. Both units were excavated to a depth of 50 cm below datum (cmbd); additional excavations were prohibited due to time constraints.

Two features were identified in Unit R12. Feature 1 was first assigned to a line of coral and shell at 11 cmbd that ran diagonally from the unit's east wall to the south wall. At 26 cmbd, a concentration of charcoal and burned clay was encountered between this coral/shell line and the southeastern corner of the unit. This concentration turned out to be an intact burned post, measuring roughly 12 cm in diameter. The post continued down to at least 50 cmbd, where it tapered down to nearly 6 cm in diameter and was supported by large pieces of coral.

Feature 4 was a concentration of coral, stone, and coral and shell rubble that appeared at roughly 50 cmbd, in the southern-middle portion of the unit. This feature surrounded a concentration of 10YR3/4 sandy loam mixed with shell, bone, and charcoal. Because of time constraints, however, the team was unable to ascertain what this feature could have been.

Excavation Unit R12 represents an intact deposit of cultural remains that can be dated, just by pottery styles, to the late Saladoid and early Ostionoid transitional period. Due to time constraints the unit could not be completely excavated to sterile subsoil. At 50 cmbd, the amount of midden materials, after a gradual decrease in density, was beginning to increase.

At EU Z29, portions of several pottery vessels were uncovered at 40 cmbs that had broken in place. Given the unit's location in a swell at the base of the slope, much of the upper 35 cm appears to have consisted of erosional deposit that was washed down from the slopes above. Historic artifacts, namely two pieces of late eighteenth century ceramics and a hand wrought nail, were uncovered in the upper 15 cm of the northern portion of the unit (at 30-40 cmbd).

The ceramic assemblages from these investigations indicate that the Judith's Fancy site was occupied during the Coral Bay — Longford through Magens Bay — Salt River I periods. Radiocarbon dates obtained as a result of the 2005 investigations place the period of occupation between cal A.D. 540 to 890 (2 sigma).

Based on the evidence gathered from sparse investigations spanning 80 years, it can be postulated that the Judith's Fancy prehistoric site was not merely an activity area. It is possible that the site was a kind of "satellite community" of the Salt River Point/Columbus Landing site across the bay. Additionally, there is scant archaeological evidence for historic occupations at Salt River, save the remains of the earthen Fort Salé located on Salt River Point.

Limetree Bay (Canegarden Bay or Krause Lagoon; 12VAm1–45)

There is some confusion regarding the exact location of the Limetree Bay site. As it was originally reported, this site was located near Krause Lagoon, on a limestone terrace behind a coastal berm that was between the shore and the mangrove-fringed lagoon. In 1951, Vescelius visited the site but did not conduct any excavations or collect artifacts from the ground surface. In the early 1960s, the Hess Oil Refinery was constructed, obliterating the lagoon and the coastal shoreline of Limetree Bay (see Figure 9b). In 1978, an attempt was made by OAS to relocate the site. The OAS archaeologists found evidence of an archaeological site on neighboring Canegarden Bay, and surmised that this was the actual location of the Limetree Bay site. In 1982, the area was visited again, and this time Saladoid series pottery was observed on the ground surface near an exposed limestone outcrop on the beach. Nearby is a large salt pond with a fringing mangrove community. On the other hand, discussions with Alfredo Figueredo (2007 personal communication) revealed that there was a site on Limetree Bay. However, because Krause Lagoon and the surrounding area was completed developed, there is little chance of proving that there actually was a site at Limetree Bay.

When the 1958 quad maps were studied, several factors were noted that would argue for the presence of a prehistoric village, quite possibly a large one, was located on Limetree Bay. First, a large gut/stream emptied into the lagoon. Second, the lagoon itself, with mangroves, nearby coral reefs, and sandy beaches would have provided ample reliable resources to place a permanent village. Prior to the construction of the refinery, Krause Lagoon was the largest mangrove community in the Virgin Islands. Most other shore or near-shore communities have been noted as being located at the mouths of guts near salt ponds, mangroves, and sandy beaches. Third, the soils surrounding the refinery are defined as alluvial Hesselberg clays, which are well-drained clayey to gravelly loams and good for agriculture. Early Saladoid period sites tend to be located on either Hesselberg clays or Glynn gravelly loams. It is likely that there were, in fact, two communities, one at Limetree Bay near Krause Lagoon, and another at Canegarden Bay.

The site was reported as a shell midden dating to the Saladoid period, ca. A.D. 100 – 700, based on ceramic styles. It is estimated that the site measured 150 m by 20 m.

Longford (12VAm1–9)

The Longford site is one of the most discussed and little studied archaeological sites on the island (similar to the St. Georges site, discussed later in this section). Despite it being a type site for the Late Saladoid period on St. Croix, there has been little systematic investigation conducted. The site encompasses just over six acres, and is located on the inland coastal plain on the south side of the island, and is believed to correspond to the Late Saladoid through Early Ostionoid transitional period (ca. A.D. 600 – 800).

The site was visited by Hatt in 1924, where he collected numerous artifacts; the total number of artifacts he collected is not known, and analysis has never been conducted on these materials. Hatt did draw a rough sketch of the site, where he illustrated two horseshoe-shaped middens that faced the ocean. Others who have visited the site include Norby (1903 – 1924) and Vescelius (1951). Unfortunately, the middens that once stood were bulldozed in the 1950s, but there is the possibility that the bases of the middens are still largely undisturbed.

Milord Point (12VAm1–52)

The Milord Point site is located on the south side of St. Croix, just west of Great Pond and on the west side of Great Pond Bay. The site was investigated by Vescelius during the 1951 St. Croix survey, and described as a shell midden comprising Analysis Units 11 and 12. Vescelius and the survey team excavated a minimum of four pits, each with two levels (A and B); Analysis Unit 11 was Pit #1, and Analysis Unit 12 was Pit #4. Pit #1 Level A was dominated by Santa Elena style (82 percent of 402 sherds) followed by Ostiones (16 percent), and Level B by Ostiones (78 percent of 85 sherds) with some Cuevas style wares (12 percent). Pit #4 was composed primarily of Cuevas style sherds in both levels (Level A=79 percent of 311 sherds were Cuevas, Level B=96 percent of 131 sherds), followed by Ostiones (Level A=21 percent, Level B=four percent). Based on ceramic typology the site has been dated to ca. A.D. 500 – 1200, or from the Late Saladoid through Ostionoid periods.

This site was visited again in the early 1980s, where several burials were encountered in test excavation pits just uphill from the shoreline site. Pottery and marine shell have been recovered, in addition to human remains. It was estimated to measure roughly 300 m by 250 m in size, but shallow in depth. There are no known radiometric dates for the site, and it is not listed on the National Register of Historic Places.

Oxford (12VAm1–49)

The Oxford site is located in a small valley in the northwestern mountainous region of the island, just over 1 km upstream from Jolly Hill and nearly 1.2 km south of the Pleasant Valley site. This small site is described as a surface scatter of prehistoric pottery sherds and small amounts of marine shell, and based on the pottery attributes has been attributed to the Late Saladoid and Early Ostionoid periods (late Coral Bay — Longford through Magens Bay — Salt River II phases). Historic Afro-Crucian wares have also been recovered. The site has been visited by Andersen, and Vescelius (1952), but to date systematic excavations have not been conducted, and no radiometric dates have been obtained.

Pleasant Valley (12VAm1–63) and Mount Victory (12VAm1–24)

Among the inland archaeological sites that have attracted the most attention by avocational artifact hunters yet the least by professionals, the Pleasant Valley and Mount Victory sites rank at the top. Mount Victory was visited by Vescelius in 1951, and Andersen collected from Pleasant Valley. The exact sizes of these sites, located on a raised plain in the northwest mountainous region in the upland valley along Creque Gut, is unknown, but based on the boundaries drawn on quad maps materials have been recovered across an area encompassing some 54 (Pleasant Valley) and 15 (Mount Victory) acres. Pleasant Valley was first occupied during the Coral Bay — Longford phase, while Mount Victory was first occupied a bit later, during Magens Bay — Salt River I phase. It is not known if the Mount Victory site actually represents an Early Ostionoid period population expansion of the village at Pleasant Valley, since it is located about 500 m to the west.

Marine shell, including *Strombus* sp., *Codakia* sp., *Lucina* sp., and oysters has been recovered from these inland sites. Artifacts that have been recovered by local collectors include a carved coral turtle, and stone collar fragements and stone celts (possibly polished) that are typically associated with hierarchically important Ostionoid period sites that also have stone-lined ball courts (Alegría 1983:5). When compared to Ostionoid period settlements and ballcourts from Puerto Rico and Hispaniola some interesting correlations can be made. Alegría found (1983), in his study of ball courts and ceremonial plazas throughout the Greater Antilles, that the majority of these site were located primarily in the central interior hilly and mountainous regions of the island Puerto Rico; on Hispaniola, ball courts have also been reported near creeks and rivers in interior valleys and terraces. A stone-lined batey was also discovered in the central hilly region of Vieques (Alegría 1983:112). In all cases, ball courts were rarely found on the coast, though some on Puerto Rico are located in the Coastal Plain, and on both Puerto Rico and Hispaniola petroglyphs have been observed on boulders in or near rivers located in close proximity to ball courts; as described earlier, this pattern is found throughout Lowland Amazonia, and are indicative of mythic locations of activities of culture heroes or ancestors. If these patterns for locations of ball courts and large plaza sites are true for the regional development of a hierarchical interaction sphere encompassing the Greater Antilles and northern Lesser Antilles (Leeward Islands), as indicated by ceramic traits, then additional stone lined ball courts should be present on St. Croix. They, too, would be located on interior terraces and in valleys next to rivers and creeks, and their convergences.

Prosperity (a.k.a. Krause, 12VAm1–11)

The Prosperity site has been investigated several times since the 1920s, though only one systematic excavation has been conducted. Gudmond Hatt visited Prosperity in 1923, and Herbert Krieger conducted excavations in 1937; however, Krieger never analyzed the materials he recovered. Folmer Andersen collected extensively from the site during the 1920s and 1930s, and collections of surface materials were made during the 1951 St. Croix Archaeology Project. All of these investigations describe Prosperity as unusual for its pottery and stone artifacts, namely beads and unfinished performs and raw materials. The pottery is described as resembling wares from the Lesser Antilles, with few attributes of Greater Antillean styles. It has been hypothesized that the people living at Prosperity maintained interaction and trade networks of small carved stone beads and ornaments with people in villages on Montserrat (the Trants site), Vieques (La Hueca/Sorcé site), and Trinidad (Pearls site), among others.

Archaeological investigations were conducted at Prosperity from 1976 to 1979, by Gary Vescelius (then the Territorial Archaeologist for the Virgin Islands) and the Virgin Islands Office of Archaeological Services, Government of the Virgin Islands. The artifacts collected during these investigations have not been completely analyzed, and the results have never been published. A single paper was presented by Vescelius and Linda Robinson at the Eighth International Congress of Caribbean Archaeology (1979), held in St. Kitts and Nevis; this paper was also never published. They described the recovery of a number of stone ornaments in various stages of manufacture, resembling archaeological finds from Trants, Montserrat, Sorcé, Vieques, and Tecla, Puerto Rico. These artifacts were divided into 10 categories (Table 8) and included calcite (dog-tooth and Iceland spar), amethyst, aventurine, bull quartz, carnelian, serpentine, actinolite, hornblende, garnet, epidote, peridot, garnet, and turquoise or chrysocolla.

Based on notes and sketches located at the Vescelius Papers housed at Yale University's Peabody Museum, it appears that 20 excavation units, measuring one by two meters and separated by 20cm balks, were dug across the site. Levels in each unit were dug in natural strata. Human remains were encountered in one small zone in an area designated Sector A, near the edges of middens that appear to have been horseshoe shaped. There is no description, drawing, or diagram of the positioning of these interments.

Table 8. Stone ornament groups recovered from the Prosperity site (Vescelius and Robinson 1979).

Group Number	***Description***
1	finished and unfinished tubular beads
2	a single barrel-shaped bead
3	petaloid beads and blanks
4	semi-ovoid beads and blanks
5	discoidal beads and blanks
6	flat quadrilateral beads and blanks
7	a single adz-like pendant
8	two zoomorphic pendants
9	bodkin-like pendant fragment
10	unworked piece of dog-tooth spar crystal

Although over 30 radiocarbon samples of shell and charcoal remains were taken during the 1976 through 1979 investigations and estimates were made regarding their expected findings, no radiometric dates are known to exist. Based on ceramic attributes and styles the site has been dated to the Early Saladoid, and is regarded as the "type site" for this earliest phase on St. Croix (the rough equivalent of Hacienda Grande and La Hueca on Puerto Rico). The site was listed on the National Register of Historic Places in 1976, at the state level. The materials recovered from these excavations should be analyzed and the results published, and additional excavations should be undertaken with a focus on the possible communication and exchange relations between the peoples of St. Croix, the islands of the Lesser Antilles, and the South American "homeland." Remote sensing technologies, like ground penetrating radar (GPR), could be used to identify the locations of older excavation units, in addition to defining any additional interments.

Richmond (12VAm–4)

The Richmond site was located on the northern shore of St. Croix, east of the Judith's Fancy site and west of Christiansted. The site was located north of Richmond Plantation, spanning inland from the shoreline some 200 m, near Water Gut. The site measured roughly 200 by 150 m.

There is little known archaeologically about the Richmond site. Vescelius investigated the site in 1951 during the St. Croix Archaeological Survey. The report from this project is the only known archaeological publication for the site. It is likely that Gudmond Hatt visited the site. Local residents interested in the island's history have also collected from the site. Folmer Andersen visited this site but there is little provenience information associated with the objects he collected. However, he did recover 173 specimens of freshwater bivalves (naiads) of species found only in the Amazonian and Orinocan basins (*Nerida* sp.), genus *Prisodon*, from both the Richmond and St. Georges sites. These shells were carved in a variety of geometric designs.

Based on Vescelius' report, the site consisted of a cleared plaza surrounded by several middens. The Yale team excavated five test pits, two large trenches, and four excavations pits (or units), that comprised Analysis Units 1 and 2 in the final report; Analysis Unit 1 was Pit #2, and Analysis Unit 2 was Trench #3. The middens were determined to have been disturbed but no further descriptions regarding the nature of the disturbance were given other than they were likely from previous excavations.

Using ceramic series names from Puerto Rico, Vescelius attributed the majority of ceramics to the Cuevas period, followed by Ostiones and Santa Elena. Today, these periods are referred to as Coral Bay — Longford, Magens Bay — Salt River I, and Magens Bay — Salt River II, respectively. One sherd was determined to be a Palo Seco style, which is found on Trinidad and dates to the Late Cedrosan Saladoid period.

A single radiometric date has been obtained for the site, during and inventory and analysis of human remains housed in the Folmer Andersen Collection at the National Park Service's Christiansted National Historic Site. A single human skeletal sample of collagen was tested and produced a date between cal A.D. 620 and 690 (2 sigma) (Wentz 2007). The Richmond site was never listed on the National Register of Historic Places, and the majority of it was destroyed during the construction of a housing development and an industrial complex. There is a remote chance that some of the site remains undisturbed, but this potential has never been determined.

River (12VAm1–22)

There is little known archaeologically about the River site. The only known excavations were conducted by Vescelius during the 1951 survey. The report from this project is the only known archaeological publication. Based on the ceramic styles, Vescelius attributed the site to the Coral Bay — Longford through Magens Bay — Salt River II periods.

Vescelius' work at River comprised two of the analysis units used in the final report (Analysis Units 9 and 10). Vescelius and his team placed a minimum of five excavation pits, located in a flat area between a gut and a "large cultivated canepiece;" the total number of excavation pits is unknown. Pits 4 and 5 (Analysis Unit 10) were located on the edge of a deep gut. The profile drawings of these units illustrate a likely hearth. Unfortunately, there is no description of this profile or of the hearth, and without a site map it is not known in which wall this hearth was located. Based on the profile sketches, the hearth began at roughly two feet below the ground surface, and was comprised of a top layer described as "red burned earth and white ash" (Vescelius 1952:53) that was roughly six inches deep. This was underlain by "friable dark earth" that was also about one-half foot thick. It is not known if soil samples were taken.

The majority of ceramics from the upper levels of Analysis Unit 9 were attributed to the Santa Elena style (76 percent), with Cuevas style wares increasing as excavations continued down. By Level E, Cuevas style sherds comprised about 87 percent of all sherds from the unit. In Pits 4 and 5, the upper levels (A through C) were mixed, likely due to plowing. Overall, the Cuevas style comprised roughly 57 percent of 596 sherds that were excavated, while in Levels E they were 83 percent of 384 sherds, and Level F, 99 percent of 78 sherds total.

Based on the current level of information available, the River site dates to the Coral Bay — Longford period, and was possibly occupied during the Early Saladoid period (Prosperity phase). There are no known radiometric dates for the site. During the 1982 inventory of archaeological sites across the island, artifacts were reported to be eroding from a 15-foot deep gut. Plowing has substantially disturbed the site, but there is a chance that there are still intact deposits. The site was listed on the National Register of Historic Places in 1976, at the state level.

Salt River (a.k.a. Columbus Landing site, 12VAm1–6)

The Salt River site (a.k.a. Columbus Landing site) is located on the west side of Salt River Bay, on the northern side of the island. The site is located within the boundary of Salt River Bay National Historic Site and Ecological Preserve (SARI), but the Virgin Islands Government-Department of Planning and Natural Resources currently manages the 5 acre parcel that encompasses the site. In 1960, the five acre Columbus Landing site was designated a National Historic Landmark, and in 1966, was listed individually on the National Register of Historic Places. In 1992, Salt River Bay National Historic Site and Ecological Preserve was administratively listed on the National Register on the basis of its historical merits.

The majority of investigations on St. Croix, conducted by both professional and avocational archaeologists and dating back to 1880, have concentrated on the Salt River site. Like the Aklis site discussed later in this paper, the majority of these investigations were conducted without systematic scientific control and there is little to no provenience information, maps, or photographs. Based on the ceramic assemblages housed in collections both in the United States (St. Croix) and the Danish National Museum, the site has been dated to both the Early and Late Ceramic periods (Prosperity through Magens Bay — Salt River III periods). Despite nearly 20 separate archaeological investigations and excavations only one radiometric date has been obtained for the site. Human remains housed in the Folmer Andersen Collection at the National Park Service's Christiansted National Historic Site were tested and produced a date of cal A.D. 720 to 740 (2 sigma) (Wentz 2007).

The Columbus Landing site has received the majority of attention by archeologists and historians interested in Salt River Bay. The site, long known to island residents, was first investigated archaeologically in the late nineteenth century and has continued to be targeted by nearly every professional and novice interested in the island's prehistory. The middens were often referred to as the most productive on the island, and as a result have been the target of both archeologists and looters alike. Collections have been made and are housed in several institutions around the world, including the Danish National Museum, the Yale University Peabody Museum, the Smithsonian Institution's Museum of Natural History, and the National Museum of the American Indian. There were also collections purportedly made in 1951, by Morales Patino and Royo Guardia of the Guama Ethnological Museum (National Academy of Sciences), Havana, Cuba; however, there is only one reference to this collection, made on an updated Virgin Islands state site form (1982), and no mention occurs in any other known report.

Archaeological investigations of the Salt River watershed began toward the end of the Danish colonial period; in 1880, the first excavations at Salt River were undertaken by the French ethnologist/linguist Alphonse Louise Pinart, whose main interest may have been focused on locating and identifying rock carvings (Figueredo and Tyson 1986:224; Joseph 1989:5). Captain Holger U. Ramsing also conducted limited excavations at Salt River Point around the turn of the twentieth century (Morse 1989:30). Ramsing donated his small collection to the Danish National Museum. Dr. Christian Branch is described by Jesse Fewkes (1922:167) as also having made a small collection of Salt River materials, including several human skulls that had been recovered from the lower areas of a midden. There was an additional excavation conducted in the mid-1970s that focused on the historic Fort Salé, built, ca. 1642; however, these artifacts have yet to be analyzed and reported.

Vescelius' work at Salt River comprised one-half (six of 12) of the analysis units used in the final report, Analysis Units 3 through 8. The survey team conducted a surface collection and excavated thirteen test pits using the methods described above. A total of 11,695 historic and prehistoric artifacts were recovered from both the excavations and the surface collection at the Salt River site; all of the historic materials were associated with Fort Salé. The excavations revealed that the Cuevas culture from Puerto Rico was the primary component at Salt River, and extended across the entire site. Vescelius pushed back the proposed relative date of occupation of Salt River Point to at least ca. A.D. 400, if not earlier.

The earliest known people to occupy the Salt River Bay and estuary arrived during the Saladoid period. Archaeological investigations conducted since the late 1800s have yielded ceramics, three pointers, beads and pendants of nonlocal semiprecious stones, and human burials. Current theory holds that the Columbus Landing site, located on Salt River Point, was occupied from the initial arrival during the Saladoid era, while the Ostionoid component at Salt River Point included the only known stone-lined and carved ball and dance court east of Puerto Rico (Alegría 1983; Hatt 1923; Morse 1989, 1995, 1997). The settlement pattern at Salt River is consistent with other patterns observed both across the Caribbean and in lowland South America, as discussed above.

By the Coral Bay — Longford and Magens Bay — Salt River I phases of the Saladoid/Ostionoid transitional period, a community had been established across the bay at Hemer's Peninsula. Its role as perhaps a satellite community for growing populations at Salt River Point, a special-use area for craft production, or as a burial ground is yet unclear. Both of these sites may have been a component of a larger Salt River community that included the upstream archaeological sites known as Glynn I and II. Both sides of the bay continued to be occupied through the Ostionoid period and were presumably an outlying community within a larger Taíno cultural sphere, centered in Puerto Rico and Hispaniola. The presence of a ballcourt surrounded by both uncarved and carved stones alludes to the growing importance and cultural significance of the Salt River Point village and its neighboring communities within the developing Taíno sphere of influence.

Sprat Hall (12VAm1–12)

Sprat Hall is located on a bluff above the western shore of St. Croix, roughly 1.2 km north of the Prosperity site. The six acre site has been visited by Nordby, Andersen, Hatt, Vescelius (1951) and Figueredo (1972). The site is multicomponent, comprised of both Late Saladoid through Ostionoid prehistoric and historic (Danish colonial plantation era) remains. Based on the distribution of middens the site has been interpreted as a village, but interestingly there is relatively little shell when compared to other coastal sites. Burials have been reported, but there is no description of their positions and locations. The site is actively eroding into the sea, and artifacts (ceramic sherds, stone tools (celts), and conch) have been recovered at the mouth of a deep gut located nearby. There are no known radiometric dates for the site.

St. George (12VAm1–30)

The St. George site is one of the most discussed and little studied of all the Early Saladoid period communities on St. Croix. It is the most inland of the Prosperity phase, Early Saldoid period villages (roughly three km from the island's south shore), and is located across 15 acres of arable, fertile soil along the western bank of Mint Gut. While people have collected artifacts from the fields in and around the site, no systematic archaeological survey or excavation has ever been conducted. It is believed that the site consists of at least six separate middens that are nearly two meters deep in some places. Based on collections of cultural materials made during the first half of the twentieth century, the St. George site was first occupied during the initial stages of the colonization of St. Croix, during the early Prosperity period. White-on-red wares, zone-incised crosshatched, and utilitarian wares were recovered by Folmer Andersen, whose collection remains the most extensive from the site to date. Unfortunately, there are no notes associated with the Andersen collection that illustrate where he recovered the artifacts he collected.

The St. George site was listed on the National Register of Historic Places in 1976, at the state level. There are no radiocarbon dates for the site, and human burials were reported by Andersen.

Sugar Beach (12VAm1–54)

The Sugar Beach site is located on the northern shore of the island, some 1,200 m to the northeast of the Richmond site (12VAm1–4). Also referred to as “Golden Rock” and “Leper Colony” by Vescelius during the 1951 survey, this roughly 12 acre site was not archaeologically tested until 1978, by R. Gartley. It was visited the next year by OAS to assess potential impacts to the site by development, and again in 1982 during the OAS survey. The site’s boundaries have yet to be firmly established, but based on the scatter of artifacts on the ground surface it is estimated to cover roughly 12 acres. Based on pottery styles, it is believed that Sugar Beach was occupied by the end of the Coral Bay — Longford through Magens Bay — Salt River II phases. Even though there has been considerable development in the area, there is the potential that intact middens remain at the site. Burials have not been reported, and there are no known radiometric dates.

Cays

By the end of the Saladoid period, the peoples of St. Croix were paddling to nearby cays and small islands, the furthest being Buck Island at 1.6 miles (2.7 km) off the north coast (Figure 26). These small islands typically have no permanent source of potable water, and their rocky soils are not amenable to horticulture or agriculture. Therefore, it has been proposed by some researchers (Hardy 2006; Righter 1985) that archaeological sites on these cays represent special use camps, whether to fish, seasonally hunt sea turtles or gather their eggs, or seasonally gather migratory bird eggs. Cays and small islands have been largely ignored by archaeologists until recently, and future studies could provide valuable insight into food acquisition and seasonally-defined practices and behaviors.

Protestant Cay (12VAm1–29) is located in Christiansted harbor, and is nearly five acres in size. The island was drastically changed in the early 1960s with the construction of a resort hotel. The prehistoric site was located on top of the hill behind the hotel, and sherds and shell were reported, in 1982, as eroding from the exposed banks of the hill and from tidal flats near the former location of a salt pond. Based on pottery decorative elements, it is believed that the site dates to the middle of the Saladoid period (ca. A.D. 300) and continued to be visited until around A.D. 700. There are no known radiometric dates for this site.

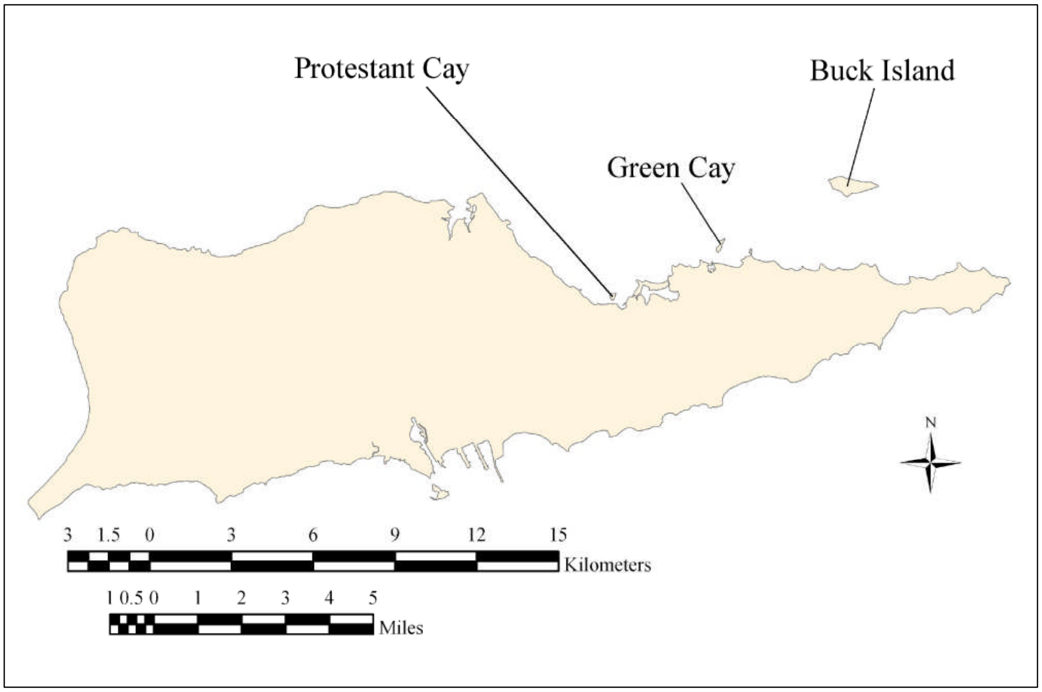


Figure 26. Map showing the locations of cays discussed in text.

The Green Cay site (12VAm1–69) is located roughly one-quarter mile off the northern shore of St. Croix, east of Christiansted, and is managed by the U.S. Fish and Wildlife Service. The small island measures about 400 m by 100 m, and consists of dry woodland and mesic forest, scrub, and beach vegetation. According to the site files, the majority of prehistoric remains on the island have been observed on the southeast shore. In 1993, Mike Evans observed human remains eroding from the northern shore. In 1994, archaeologists from the NPS' Southeast Archeological Center (SEAC) were asked to visit the island and determine the site's period of occupation and boundaries. The SEAC archaeologists saw no evidence of these remains. Based on ceramics, the site was likely occupied during the Coral Bay — Longford period. Malcom Weiss and William Gladfelter, biologists from Farleigh Dickinson University, collected *Strombus gigas* shells during a visit to the island in the 1970s; these shells were radiometrically dated to 930 +/- 140 years, or ca. A.D. 1020.

Analysis of the human remains recovered in 1993 was conducted by Rachel Wentz as part of a comparative isotopic study of human remains in the Andersen Collection (see description of the study above). Radiometric dating of the Green Cay remains produced a date of 1,170+/-40 BP, with a conventional age of 1,320 +/-40 BP, or ca. A.D 630.

Buck Island is a small uninhabited island of roughly 176 acres (70.6 ha.), located approximately two kilometers off the north coast of the eastern end of St. Croix. The island and surrounding waters, encompassing 704 acres of submerged lands (for a total of 880 acres), were established as Buck Island Reef National Monument in 1961. In 2001, the monument's marine boundary was expanded to include a total of 19,000 acres.

The Buck Island site (a.k.a. West Beach site, 12VAm1–68) was first identified as a scatter of Late Ostionoid pottery and four small conch or coral middens in 1975, after sherds were reported as eroding from the beach line by National Park Service rangers (Hardy 2006). In 1976, the site was investigated by George Fischer and Wayne Prokopetz of the National Park Service's Southeast Archeological Center. Based on ceramic attributes, the site was dated to ca. A.D. 800 through 1200. A return visit to the site by National Park Service staff, in 1978, seemed to indicate that the site had been destroyed.

In 1984, Elizabeth Righter, then Territorial Archaeologist for the Virgin Islands, conducted a pedestrian survey across the island's peaks and systematically shovel tested the Buck Island site (Righter 1985). This survey identified historic remains on the island's ridges. Systematic shovel testing was conducted at West Beach to delineate the boundaries of a prehistoric conch midden that had been reported as destroyed. Evidence that the site was not completely destroyed was gathered, though it was believed that the majority of the site had been lost to the sea.

The National Park Service's Southeast Archeological Center conducted an archeological survey and limited subsurface testing on Buck Island in July 2003 (Hardy 2006). The survey team conducted a systematic pedestrian survey of nearly 35 percent of the island's terrestrial surface, including ridges, flats, and slopes. The survey consisted of the crew members walking in parallel transects spaced at 20 m intervals. The team used for reference points a grid system that had been previously established by National Park Service personnel for a rat eradication project. This grid covered the entire island, and consisted of bait stations of rebar and PVC pipe hammered into the ground at 40 m intervals. Each bait station was previously georeferenced with a handheld global positioning system (GPS) unit. Two additional areas on the island were subjected to a similar survey strategy: the northwestern toe and ridge, and the manchineel forest and slope just above West Beach. All told, the pedestrian survey covered nearly 150 40-m squares.

In addition to relocating and identifying historic structural ruins, the team conducted systematic shovel testing at the prehistoric West Beach site. Sixteen shovel tests were excavated to discern if anything remained of the site or if it had indeed been destroyed by wind erosion and wave action. Fifteen shovel tests were excavated in roughly 20 m intervals along two parallel transects, and only three failed to produce cultural materials. Historic era artifacts, including ceramics, glass, and tobacco pipe stems and bowls, tended to cluster around the southern end of the shovel testing area, while prehistoric materials and faunal remains were clustered near the base of the slope. All cultural materials were recovered in the upper 40 cm.

The eroding shoreline at West Beach was also examined for evidence of exposed cultural materials, and markers used for sea turtle monitoring projects were used as reference points (Hardy 2006). A buried A-horizon was noticed at approximately 80 cm below the berm surface between two of these markers. When the profile was cleaned, the A-horizon proved to be a hearth eroding from the bank. Approximately 45 cm diameter of the hearth was exposed in the bank profile, with only a 25 cm-wide lens of densely concentrated fire cracked rock, indicating that much was already lost. In order to prevent further loss of the feature, the decision was made to completely excavate the hearth and float the remains.

The hearth was covered by a three cm-thick layer of clean white sand. The hearth itself, and the southwest corner of the unit, were very dark with Munsell values of 10YR 2/1, 3/1, and 4/1. The remains of the hearth measured roughly 45 by 25 cm, and was lined with flat stones and littered with charcoal, prehistoric ceramic sherds, and burned and fragmented shell. All of the contents of the hearth were collected and subjected to flotation, where it was observed that the hearth consisted primarily of large grained sand, charcoal, some fire cracked rock, a few crab claws, possible lobster antennae, and bits of shell; very little prehistoric pottery was recovered. A dense concentration of fire cracked rock, charcoal, and trace amounts of prehistoric pottery measured 25 cm square. Further examination of the exposed and eroding berm resulted in the identification of additional possible hearths, one about 5 m to the east.

Eight samples of burned wood recovered from the hearth were sent to the Florida Museum of Natural History for identification. Due to the small sizes of the samples, specific taxonomic identification was not possible, though all were determined to be Angiospermae (hardwoods). No Gymnospermae were identified among the samples, and two of the specimens did resemble buttonwood (cf. *Conocarpus* sp.).

Finally, both charcoal fragments and one *Cittarium pica* (West Indian top shell) specimen were sent for radiometric dating. The charcoal was assayed using accelerator mass spectrometry (AMS), and produced a corrected or calibrated date of cal. A.D. 410 to 600 (2 sigma), while the shell was tested using standard radiometric procedures and produced similar dates (conventional radiocarbon age of cal. A.D. 510 to 770 (2 sigma). The overlap of these two calibrated dates, A.D. 510 to 600, falls near the transition between the late Saladoid and early Ostionoid cultural periods.

Settlement Patterns and GIS Models of Land Use and Occupation

Results of Current Study

The following discussion is based on the current listings in the Virgin Islands Territorial archaeological database, site file forms, Section 106-driven projects, and conversations with archaeologists who have worked on St. Croix. Only sites with confirmed location information were defined as to their cultural and chronological associations, and those with site files were used for this analysis. While some resource extraction (chert sources) sites have recently been located near the town of Frederiksted, they have not been attributed to any particular temporal period other than "prehistoric," and were not included in this analysis. It should also be stated that this analysis has been limited by several factors, most notably the accuracy of the data reported on the site file forms and in site reports, the accuracy of the field surveys and excavations that were conducted, and the unavailability of reliable data for some sites.

Site locations, temporal and cultural affiliation, and site sizes (area) were entered into an Access database, then brought as event themes into an ESRI ArcGIS (9.2), where they were plotted onto digitized topographic quadrant maps of the island (1958) (see Figure 23). The 1958 quadrant maps were chosen because they illustrated the island's physical features prior to many of the development and land moving projects of the 1960s. Elevation and slope information was obtained from the U.S. Geological Survey's National Elevation Data Set (EROS Data Center, NOAA), using 7.5 minute elevation data converted to Universe Transverse Mercator (UTM) North American Datum (NAD) 1983 projection. Soils information was gathered from the U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS) – Soil Survey Geographic Database (SSURGO).

Currently, there are nine archaeological sites with materials attributable to the Prosperity phase, and 37 sites are associated with the Coral Bay — Longford phase. The number of archaeological sites increases during Magens Bay — Salt River I to 49, then begins to decrease to 32 in Magens Bay — Salt River II. By Magens Bay — Salt River III, there are only 19 confirmed sites on the island (Figures 27 through 30).

For the purposes of this study, coastal sites are defined as those located within one km of the shore, while the coastal plain is defined being over one km away from the shore and an elevation between sea level and 40 meters above sea level (masl).

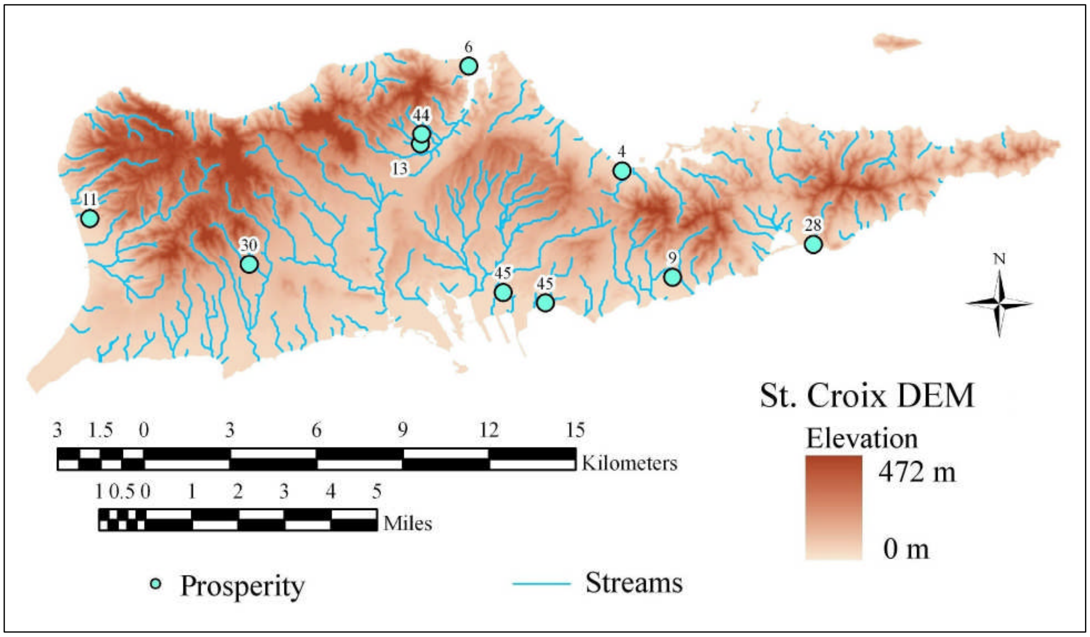


Figure 27. General map, Prosperity site distributions, using digital elevation models (DEM).

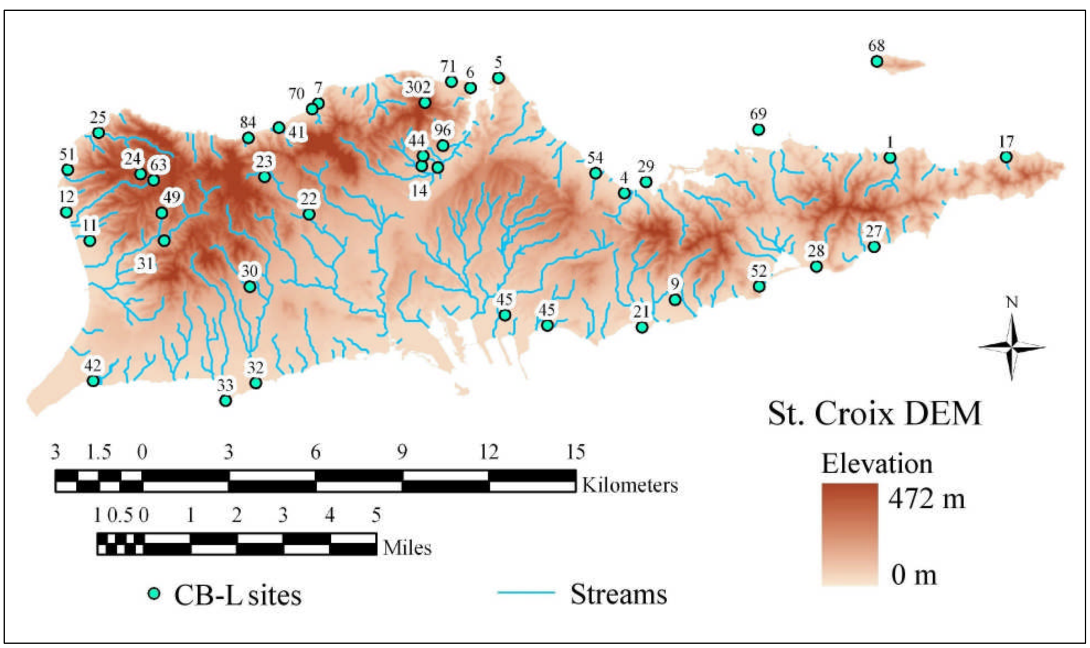


Figure 28. General map, Coral Bay — Longford site distributions, using digital elevation models (DEM).

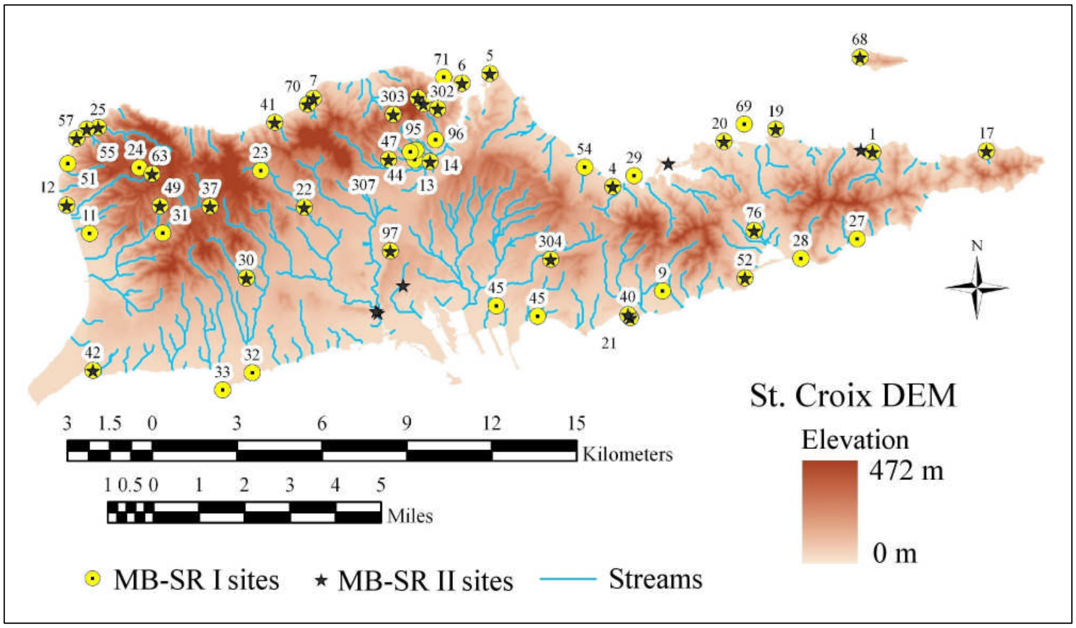


Figure 29. General map, Magens Bay — Salt River I and II site distributions, using digital elevation models (DEM).

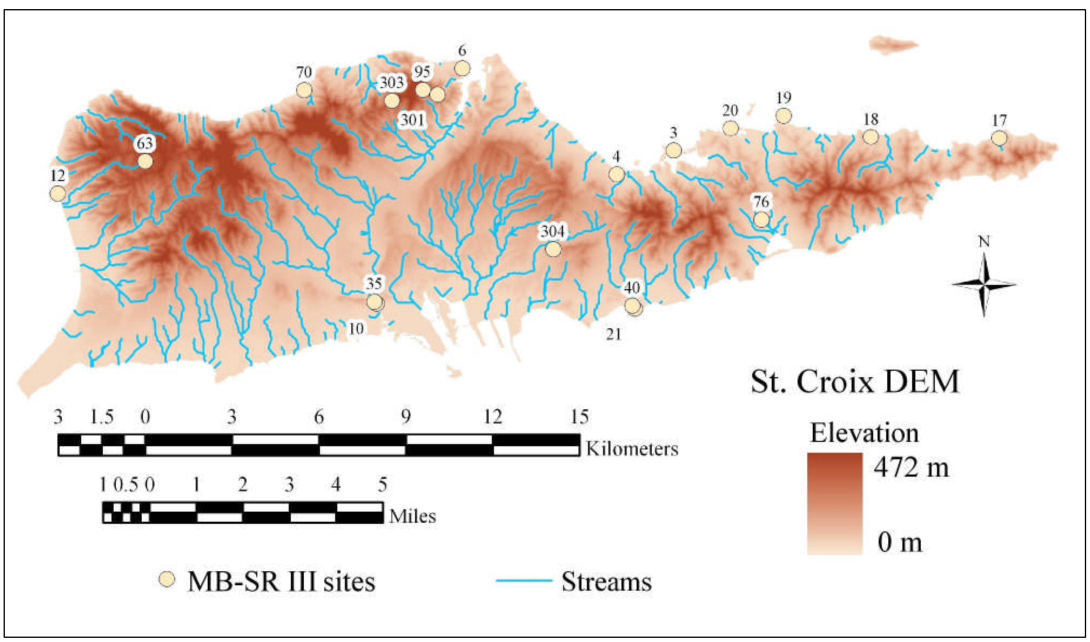


Figure 30. General map, Magens Bay — Salt River III site distributions, using digital elevation models (DEM).

Of the total of eight identified Prosperity phase archaeological sites (or settlements), all but one were located on the coast or in the coastal plain; of the 37 Coral Bay — Longford phase sites, six were located in the inland-mountainous region, 22 were on the coast, and eight were in the coastal plain. A total of eighteen sites were found to be located near the mouths of streams and watersheds throughout the Saladoid period (Prosperity = four, Coral Bay — Longford = 14), while 15 (Prosperity = four, Coral Bay — Longford = 11) sites total were located near junctures of smaller tributaries into the larger drainage system.

During the Magens Bay — Salt River I phase there were 23 settlements on the coast, ten in the coastal plain, and fourteen in the interior hills and mountainous region, all of which were located within 500 m of a drainage or stream. Six of these sites were located at the boundary between 0-40 masl and 40-94 masl, as defined by the GIS. Many of these coastal sites may not represent actual villages, but could have been look out points, fishing locales for inland settlements, or isolated, one-house locations. These settlements largely remained occupied through Magens Bay — Salt River II; however, the Glynn/Windsor, Jolly Hill, Prosperity, Butler Bay, Enfield Green, Long Point, Longford, Sugar Beach, Great Pond, Limetree Bay, Concordia Ridge 3, Gentle Winds, and Cotton Grove sites were all apparently abandoned during this period. By the Magens Bay — Salt River III period, there were only two inland, eleven coastal, and six coastal plain communities.

As described by both Vescelius (1952) and Morse (1989), the earliest Saladoid period sites were located on alluvial soils. The distributions of these sites in relation to soil types illustrates a preference for soils of the Glynn series (Table 9). The majority of all sites, regardless of chronological period, were located on Glynn soils; this is not terribly unexpected as these soils are found along the drainages, waterways, alluvial fans, and terraces (Figures 31 through 33). These are followed by settlements located on Glynn border soils, or boundaries between Glynn series and other soil series. The Annaberg-Cramer and Victory-Southgate series soils are roughly equivalent in preference; the Annaberg-Cramer series are located in the northwestern mountainous region while the Victory-Southgate series is located on the hilltops and slopes of the Salt River and the eastern hilly/mountain regions. By the Magens Bay — Salt River III phase, settlements are preferentially located on Glynn and Victory-Southgate series soils, while the Glynn-border soils are infrequently occupied. Settlements are only located on Hesselberg series soils during the Coral Bay — Longford through Magens Bay — Salt River I phases, while Arawak series soils have occupations during the Magens Bay — Salt River I and II phases.

Table 9. Chronological distribution of archaeological sites by soil type.

Soil Type	*Prosperity*	*CB-L*	*MB-SR I*	*MB-SR II*	*MB-SR III*
Annaberg-Cramer	0	5	6	4	2
Arawak	0	0	2	2	1
Glynn	5	17	21	14	9
Glynn-bordering with other soils	3	7	7	4	2
Hesselberg	0	2	2	1	0
Jaucus Sand	0	1	1	1	0
Parasol/Jealousy-Southgate	0	1	1	0	0
Southgate-Rock	0	0	1	1	1
Victory-Southgate	0	4	7	5	4
Total	8	37	49	32	19

The increase in the number of sites during the Coral Bay — Longford and Magens Bay — Salt River I phases appear, at first glance, to occur in two main patterns: as pairs, possibly the result of increasing populations and village fissioning, and along watersheds, where several sites appear to cluster near potential headwaters. Relations based on proximity (within two km) can be inferred for the following site pairs: Halfpenny and Manchenil, Salt River and both Judith's Fancy and Gentle Winds, Glynn and Windsor, Northside and Butler Bay, Enfield Green and Longpoint, Richmond and Sugar Beach, Prosperity II and Davis Bay, Milord Point and Great Pond, Prosperity and Sprat Hall, and Glynn/Windsor and Lebanon Dam. New settlements established both at the mouths of streams and at either the headwaters of these same streams or at the junction of these streams and tributaries, could be indicative of the establishment of garden plots by coastal groups that, over time, could have turned into separate villages.

In order to determine any relationships between the chronological distribution of prehistoric settlements across the landscape and their sizes with importance, a rank size analysis was conducted for all sites on the island with confirmed locations, and estimates of their site size based on surface survey and subsurface testing (when available). To review, the rank size rule (a.k.a. Zipf's law (1949), or the log-normal rule) simply states that the second largest settlement is roughly one-half the size of the first, the third largest is one-third the size of the first, etc., until the nth-sized settlement will be 1/nth the size of the first, or

$$P(n) = P(1) / n$$

(Falconer and Savage 1995; Haggett 1983). When plotted, this rule illustrates a power law distribution with an exponential distance decay, and when scaled with a logarithmic transformation a rank size distribution plots as a straight line descending from the upper left down to the right.

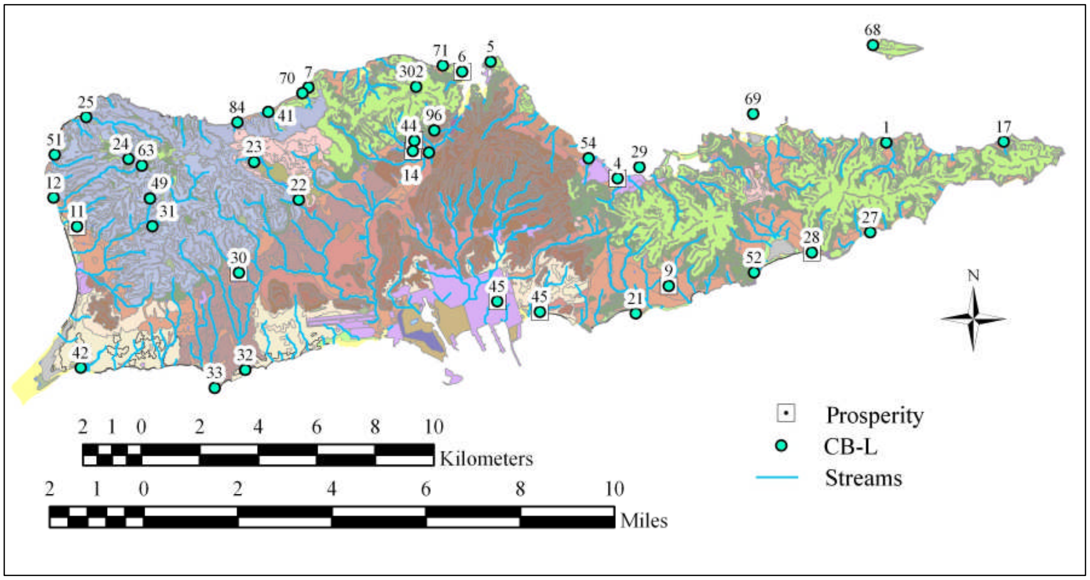
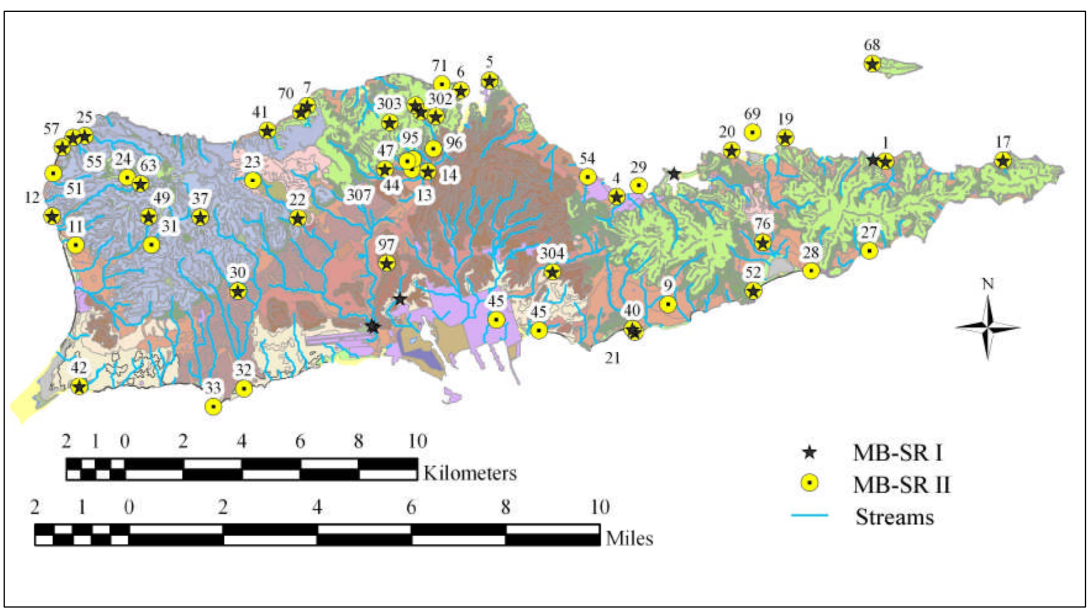


Figure 31. Soils and distribution of archaeological sites, Prosperity and Coral Bay – Longford phases. (For descriptions of soil types, see Chapter 3, Figure 7)

Figure 32. Soils and distribution of archaeological sites, Magens Bay – Salt River I and II phases.



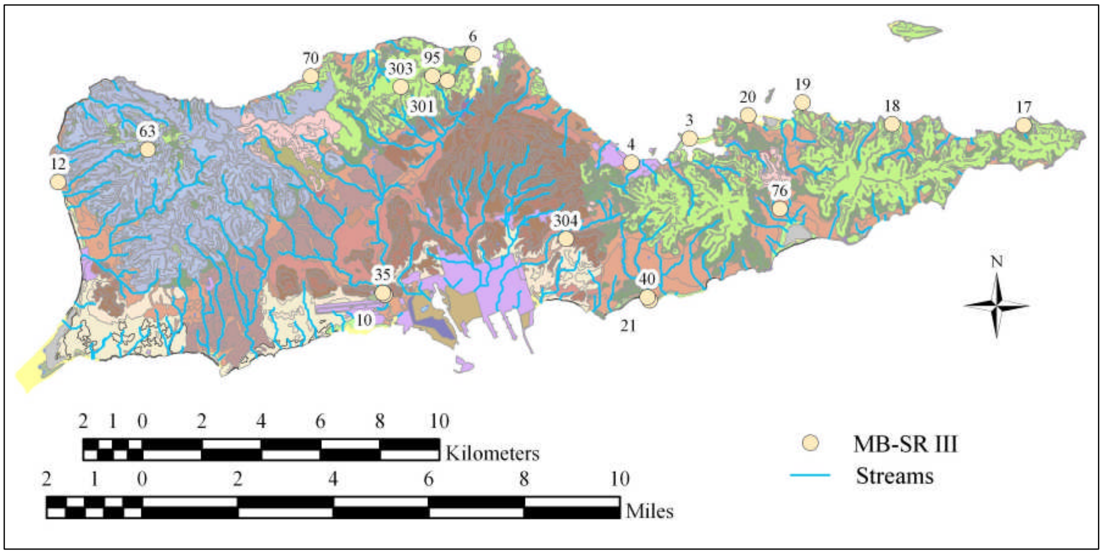


Figure 33. Soils and distribution of archaeological sites, Magens Bay – Salt River III phase.

In archaeological contexts, log-normal distributions represent the expected distribution of a regional settlement system where larger urban areas are "well integrated with their subordinate communities" (Falconer and Savage 1995:40). However, there are special cases to the rank size rule when applied to pre-industrial (and prehistoric) systems where variations from a log-normal distribution are frequent. There are four main types of variance to the log-normal distribution curve: primate, primo-convex, convex, and double convex distributions (Table 10). These variations to the log-normal curve allow for a relative comparison of different kinds of settlement systems.

There are several potential problems that can arise when applying the rank size rule to archaeological contexts. First, interpretations of settlement patterns and site distributions are actually samples of what existed in the past. The sample data is only as good as the quality and extent of survey coverage. Second, when applying a rank size distribution it is assumed that the largest settlement in the system has been identified. Third, it is assumed that there is confidence in the estimates of site sizes. Finally, it must be realized that not all sites from a particular time period were necessarily occupied contemporaneously.

Table 10. Summaries of variations of rank size distributions from log-normality. From Falconer and Savage 1995; Savage 1997.

Curve type	*Description*
Primate	Small territories; can be core areas with extreme centralization of economic and political systems; centers of sacred ceremony, elite exchange, war; can be an artificial distribution of the entire settlement system is not completely known
Convex	Low economic and political system integration; can be predicted by Central Place Theory.
Primo-convex	Primate in the upper range of site size, convex in the lower range; possible pooling of two or more settlement systems, or a centralized system over a loosely organized or central place distribution (two distinct forms of settlement in one area).
Double-convex	Many forms of settlement in a single region; steps represent settlement of roughly similar size on same tier; can represent peripheries.

Table 11. Sizes of archaeological sites per time period, in acres.

Acreage Groups	***Prosperity***	***CB-L***	***MB-SR I***	***MB-SR II***	***MB-SR III***
x≥50	0	1	1	1	1
30<x<40	1	3	2	1	1
20<x<30	0	1	2	2	2
10<x<20	6	15	19	10	5
6<x<10	0	7	10	6	4
0<x<6	1	10	14	11	5

Note: no sites were reported that were between 40 and 50 acres in size.

Some of these figures may be errant, however, in that some sizes were estimated based on surface scatter alone without any subsurface testing. Discussions with the current Territorial Archaeologist (D. Brewer 2007, personal communication) revealed that, for the most part, site areas as drawn on the Virgin Islands quadrant maps (1:24,000) should be used when other information was ambiguous or unlisted (Table 11). For the purposes of this study, it was assumed that roughly 75 percent of the land of St. Croix has been archaeologically surveyed, and that there is the potential for new archaeological sites to be discovered that may alter the results of this study.

The site sizes were graphed on a log-log scatter plot, and ranked in descending order per cultural and chronological period (Tables 12, 15, 16, 18, 20; Figures 34 through 38). As previously discussed, larger sites are typically assumed to have larger populations, and therefore are likely more important than small sites (which would typically represent individual households or single Houses, camps, or special resource locations). It appears that the initial colonizing population consistently lived in communities that covered between 10 and 20 acres, though this size could have encompassed the entire territory, including gardens plots. Not all of these sites represent potential villages. Certain sites were likely defensive outposts or lookouts, such as the small sites that measure barely one acre in size, those located on the mountain tops above Salt River and across the Northwest Range, and those located on rocky outcrops and points at the water's edge. Throughout all phases the majority of sites are between 10 and 20 acres in size. Beginning in the Coral Bay — Longford phase, the next most numerous site size categories were the smallest sites (between zero and six acres), followed by those sites between six and 10 acres.

The Rank Size Distribution Program v.3.2.2, created by Stephen Savage (University of Arizona), was used to run Monte Carlo simulations and a Kolomogorov–Smirnov one sample goodness of fit test (K-test), which evaluates the observed rank-size plots and compares them to an expected, log-normal distribution (Tables 13, 15, 17, 19, 21) (Savage 1997:235). Finally, a least squares regression was run on the rank-size plot, where Q (magnitude of forces of diversification divided by magnitude of forces of unification, see Zipf's Law) was not assumed to be one, but determined based on a least squares regression with the assumption that Q does not equal one in all circumstances (Savage 1997).

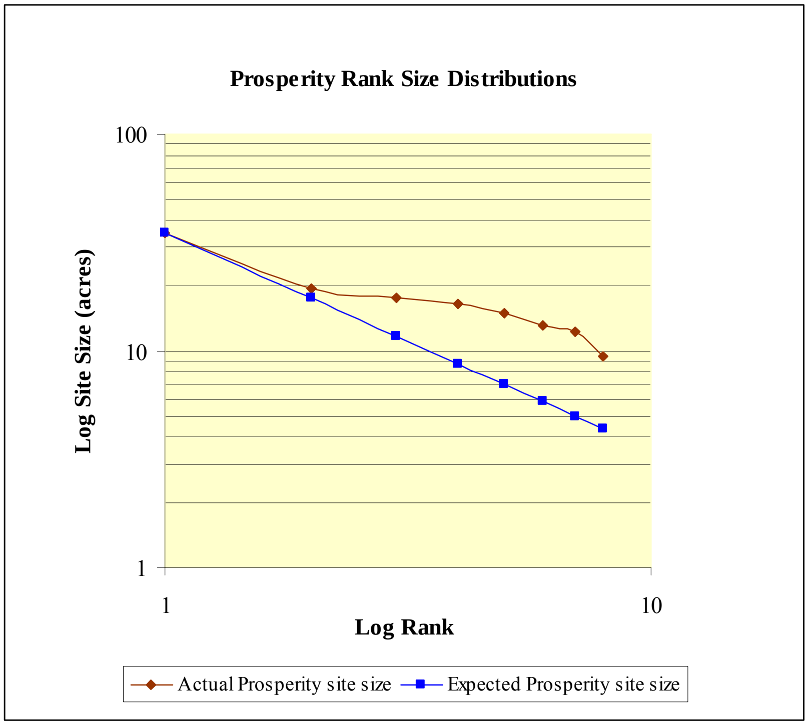


Figure 34. Log-log rank size distributions of St. Croix's Prosperity sites, by time period and cultural affiliation.

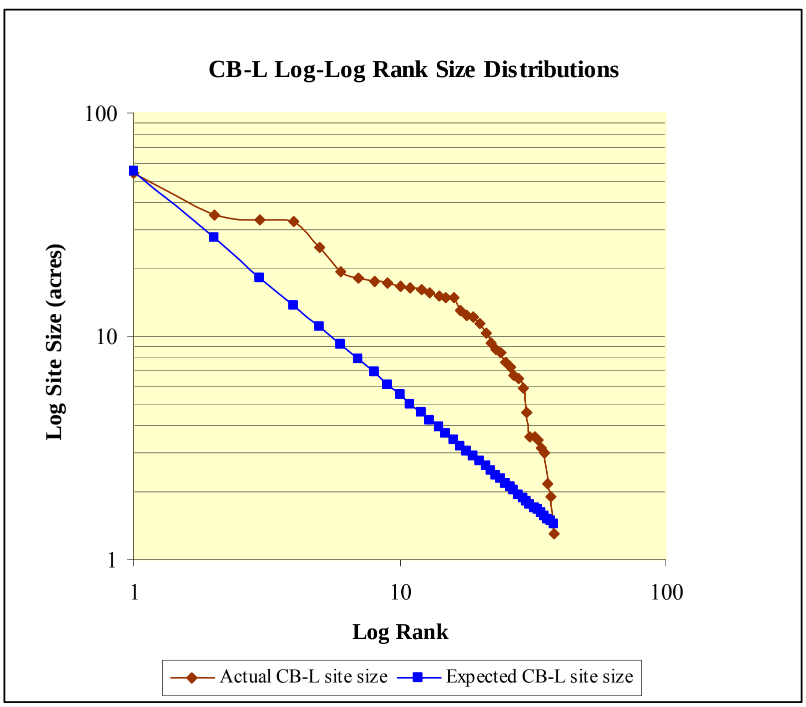


Figure 35. Log-log rank size distributions of St. Croix's Coral Bay — Longford sites, by time period and cultural affiliation.

Table 12. Site sizes and soil types for Prosperity phase sites.

Name	*Site #*	*Rank*	*Size (acres)*	*Soil Type*	*Name*	*Site #*	*Rank*	*Size (acres)*	*Soil Type*
Windsor	44	1	35.04	Gy/Ar	Richmond	4	5	15.02	Gy
Glynn	13	2	19.56	Gy	Longford	9	6	13.07	Gy
Great Pond	28	3	17.50	Gy	St. Georges	30	7	12.19	Gy/Hg
Prosperity	11	4	16.40	Gy	Salt River	6	8	9.42	Gy/So

Note: abbreviations for soil types are as follows. Ar=Arawak, Gy=Glynn, Hg=Hogensborg, So=Solitude, Vs=Victory-Southgate.

Table 13. K-values for actual and least squares regression of rank size distributions (assuming 75 percent coverage), Prosperity sites.

K-value, Monte Carlo simulation, 10,000 runs, actual data	0.625, where Q=1
Description Monte Carlo simulation, 10,000 runs, actual data	Simulated K-value equaled or exceeded the actual value 0 times in 10,000 runs. The estimated probability of drawing a sample of 8 sites with the observed k-value from a log-normal distribution is < 0.0001. There were 8 sites in the simulated universe.
K-value, least squares regression	0.25, where Q=-2.748
Description of K-test, least squares regression	Simulated K-value equaled or exceeded the actual value 10,000 times in 10,000 runs. The estimated probability of drawing a sample of 8 sites with the observed k-value from a log-normal distribution is 1. There were 8 * (1 / 0.75) = 10 sites in the simulated universe.

Table 14. K-values for actual and least squares regression of rank size distributions (assuming 75 percent coverage), Coral Bay — Longford sites.

K-value, Monte Carlo simulation, 10,000 runs, actual data	0.526, where Q=1
Description Monte Carlo simulation, 10,000 runs, actual data	Simulated K-value equaled or exceeded the actual value 0 times in 10,000 runs. The estimated probability of drawing a sample of 38 sites with the observed k-value from a log-normal distribution is < 0.0001. There were 38 * (1 / 0.75) = 50 sites in the simulated universe.
K-value, least squares regression	0.553, where Q=-0.868
Description of K-test, least squares regression	Simulated K-value equaled or exceeded the actual value 0 times in 10,000 runs. The estimated probability of drawing a sample of 48 sites with the observed k-value from a log-normal distribution is < 0.0001. There were 38 * (1 / 0.75) = 50 sites in the simulated universe.

Table 15. Site sizes and soil types for CB-L phase sites.

Name	*Site #*	*Rank*	*Size (acres)*	*Soil Type*	*Name*	*Site #*	*Rank*	*Size (acres)*	*Soil Type*
Pleasant Valley	63	1	54.30	Ac	Judith's Fancy	5	23	8.69	So/Vs
Windsor	44	2	35.04	Gy/Ar	Concordia Ridge 3	96	24	8.49	Gy
Sprat Hall, Sprat Hole	12	4	32.69	Ac	Jolly Hill	31	25	7.69	Ac
Butler Bay	51	5	24.90	Gy	Cramer Park	17	26	7.23	Gy
Glynn I	13	6	19.56	Gy	Buck Island	68	27	6.66	Ja
Cotton Grove	27	7	18.33	Gy/Cv	Protestant Cay	29	28	6.49	Vs
Great Pond	28	8	17.50	Gy	Cotton Valley	1	29	5.87	Gy
River	22	9	17.36	Gy	Ham's Bay	25	30	4.60	GyAc
Milord Point	52	10	16.88	Gy	Green Cay	69	31	3.55	Vs
Prosperity	11	11	16.40	Gy	Northstar	41	32	3.53	Gy
Fountain	23	12	16.35	Pa/Js	Clairmont Hill	302	33	3.45	Vs
Cane Bay	7	13	15.72	Gy	Long Point	33	34	3.15	He
Enfield Green	32	14	15.10	Gy /He	Oxford	49	35	3.03	Ac
Richmond	4	15	15.02	Gy	Glynn II	14	36	2.21	Gy
Aklis	42	16	14.84	He	Gentle Winds	71	37	1.93	Gy/Sr
Longford	9	17	13.07	Gy	Mt. Victory	24	38	1.32	Ac
Sugar Beach	54	18	12.51	Gy					
St. Georges	30	19	12.19	Gy/Hg					
Halfpenny Bay	21	20	11.45	Gy					
Davis Bay	84	21	10.26	Gy					
Salt River	6	22	9.42	Gy/ So					

Note: abbreviations for soil types are as follows. Ac=Annaberg-Cramer, Ar=Arawak, Cv=Cramer-Victory, Gy=Glynn, He=Hesselberg, Hg=Hogensborg, Ja=Jaucus Sand, Js=Jealousy, Pa=Parasol, So=Solitude, Sr=Southgate-Rock, Vs=Victory-Southgate.

Table 16. Site sizes and soil types for MB-SR I phase sites.

Name	*Site #*	*Rank*	*Size (acres)*	*Soil Type*	*Name*	*Site #*	*Rank*	*Size (acres)*	*Soil Type*
Pleasant Valley	63	1	54.30	Ac	Salt River	6	26	9.42	Gy/So
Windsor	44	2	35.04	Gy/Ar	Punnett Point	20	27	9.16	Gy
Sprat Hall, Sprat Hole	12	3	32.69	Ac	Judith's Fancy	5	28	8.69	So/Vs
Work and Rest	304	4	25.50	Ar	Concordia Ridge 3	96	29	8.49	Gy
Butler Bay	51	5	24.90	Gy	Jolly Hill	31	30	7.69	Ac
Glynn I	13	6	19.56	Gy	Concordia Ridge 2	301	31	7.54	Vs
Cotton Grove	27	7	18.33	Gy/Cv	Cramer Park	17	32	7.23	Gy
Great Pond	28	8	17.50	Gy	Buck Island	68	33	6.66	Ja
River	22	9	17.36	Gy	Protestant Cay	29	34	6.49	Vs
Milord Point	52	10	16.88	Gy	Cotton Valley	1	35	5.87	Gy
Prosperity	11	11	16.40	Gy	Kingshill	97	36	5.85	Ar
Fountain	23	12	16.35	Pa/Je	Ham's Bay	25	37	4.60	Gy/ Ac
Northside I	55	13	16.01	Gy	Concordia Ridge 1	95	38	3.76	Vs
Cane Bay	7	14	15.72	Gy	Green Cay	69	39	3.55	Vs
Enfield Green	32	15	15.10	Gy	Northstar	41	40	3.53	Gy
Richmond	4	16	15.02	Gy	Clairmont Hill	302	41	3.45	Vs
Aklis	42	17	14.84	He	Long Point	33	42	3.15	He
Longford	9	18	13.07	Gy	Oxford	49	43	3.03	Ac
Bonne Esperance	303	19	12.71	Vs	Lebanon Dam	307	44	2.42	Gy
Sugar Beach	54	20	12.51	Gy	Glynn II	14	45	2.21	Gy
St. Georges	30	21	12.19	Gy	Gentle Winds	71	46	1.93	Gy
Manchenil Bay	40	22	11.48	Gy	Mt. Victory	24	47	1.32	Ac
Halfpenny Bay	21	23	11.45	Gy	Pull Point	19	48	1.16	Sr
Davis Bay	84	24	10.26	Gy	Hartman	76	49	0.01	Gy
Montpellier	37	25	9.65	Ac					

Note: abbreviations for soil types are as follows. Ac=Annaberg-Cramer, Ar=Arawak, Cv=Cramer-Victory, Gy=Glynn, He=Hesselberg, Hg=Hogensborg, Ja=Jaucus Sand, Js=Jealousy, Pa=Parasol, So=Solitude, Sr=Southgate-Rock, Vs=Victory-Southgate.

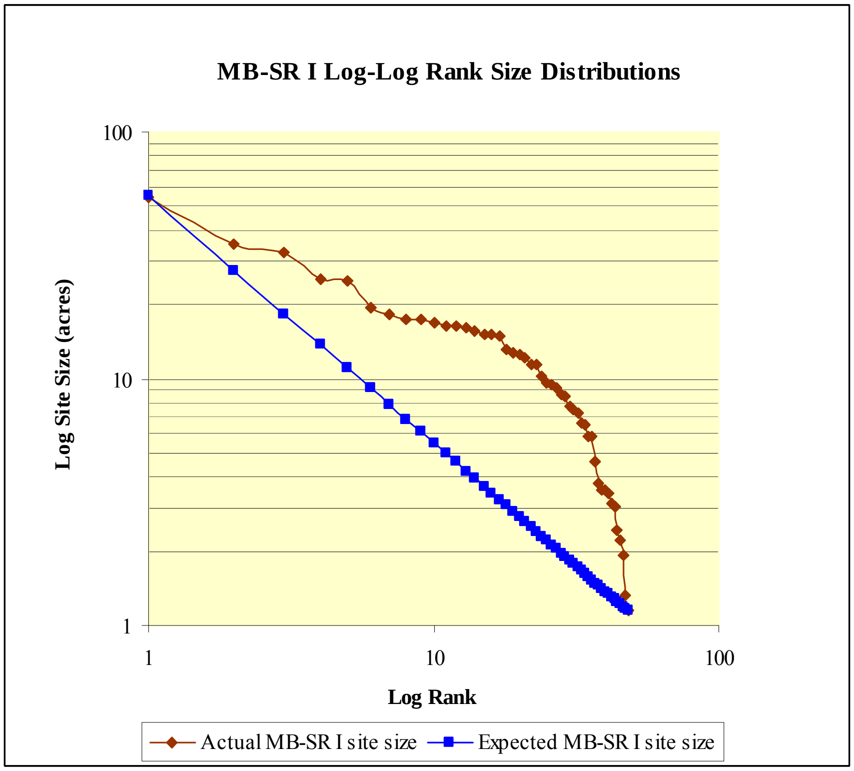


Figure 36. Log-log rank size distributions of St. Croix's Magens Bay — Salt River I sites, by time period and cultural affiliation.

Table 17. K-values for actual and least squares regression of rank size distributions (assuming 75 percent coverage), Magens Bay — Salt River I sites.

K-value, Monte Carlo simulation, 10,000 runs, actual data	0.563, where Q=1
Description Monte Carlo simulation, 10,000 runs, actual data	Simulated K-value equaled or exceeded the actual value 0 times in 10,000 runs. The estimated probability of drawing a sample of 48 sites with the observed k-value from a log-normal distribution is < 0.0001. There were 48 * (1 / 0.75) = 64 sites in the simulated universe.
K-value, least squares regression	0.688, where Q=-0.613
Description of K-test, least squares regression	Simulated K-value equaled or exceeded the actual value 0 times in 10,000 runs. The estimated probability of drawing a sample of 48 sites with the observed k-value from a log-normal distribution is < 0.0001. There were 48 * (1 / 0.75) = 64 sites in the simulated universe.

Table 18. Site sizes and soil types for MB-SR II phase sites.

Name	Site #	Rank	Size (acres)	Soil Type	Name	Site #	Rank	Size (acres)	Soil Type
Pleasant Valley	63	1	54.30	Ac	Punnett Point	20	17	9.16	Gy/Cv
Sprat Hall, Sprat Hole	12	2	32.69	Ac	Concordia Ridge 2	301	18	7.54	Vs
Fair Plain	10	3	29.63	Gy	Cramer Park	17	19	7.23	Gy
Work and Rest	304	4	25.50	Ar	Buck Island	68	20	6.66	Ja
					Cotton Valley	1	21	5.87	Gy
River	22	5	17.36	Gy	Kingshill	97	22	5.85	Ar
Milord Point	52	6	16.88	Gy	Beauregard Bay	3	23	5.33	Vs
Northside I	55	7	16.01	Gy	Ham's Bay	25	24	4.60	Gy/Ac
Cane Bay	7	8	15.72	Gy	Concordia Ridge 1	95	25	3.76	Vs
Richmond	4	9	15.02	Gy	Northstar	41	26	3.53	Gy
Aklis	42	10	14.84	He	Clairmont Hill	302	27	3.45	Vs
Bonne Esperance	303	11	12.71	Vs	Oxford	49	28	3.03	Ac
St. Georges	30	12	12.19	Gy/Hg	Solitude	18	29	2.85	Gy
Manchenil Bay	40	13	11.48	Gy	Lebanon Dam	307	30	2.42	Gy
Halfpenny Bay	21	14	11.45	Gy	Fair Plain 2	35	31	1.40	Gy
Montpellier	37	15	9.65	Ac	Pull Point	19	32	1.16	Sr
Salt River	6	16	9.42	Gy/So	Hartman	76	33	0.43	Gy

Note: abbreviations for soil types are as follows. Ac=Annaberg-Cramer, Ar=Arawak, Cv=Cramer-Victory, Gy=Glynn, He=Hesselberg, Hg=Hogensborg, Ja=Jaucus Sand, Js=Jealousy, Pa=Parasol, So=Solitude, Sr=Southgate-Rock, Vs=Victory-Southgate.

Table 19. K-values for actual and least squares regression of rank size distributions (assuming 75 percent coverage), Magens Bay — Salt River II sites.

K-value, Monte Carlo simulation, 10,000 runs, actual data	0.4, where Q=1
Description Monte Carlo simulation, 10,000 runs, actual data	Simulated K-value equaled or exceeded the actual value 0 times in 10,000 runs. The estimated probability of drawing a sample of 30 sites with the observed k-value from a log-normal distribution is < 0.0001. There were 30 * (1 / 0.75) = 40 sites in the simulated universe.
K-value, least squares regression	0.4, where Q=1.066
Description of K-test, least squares regression	Simulated K-value equaled or exceeded the actual value 0 times in 10,000 runs. The estimated probability of drawing a sample of 30 sites with the observed k-value from a log-normal distribution is < 0.0001. There were 30 * (1 / 0.75) = 40 sites in the simulated universe.

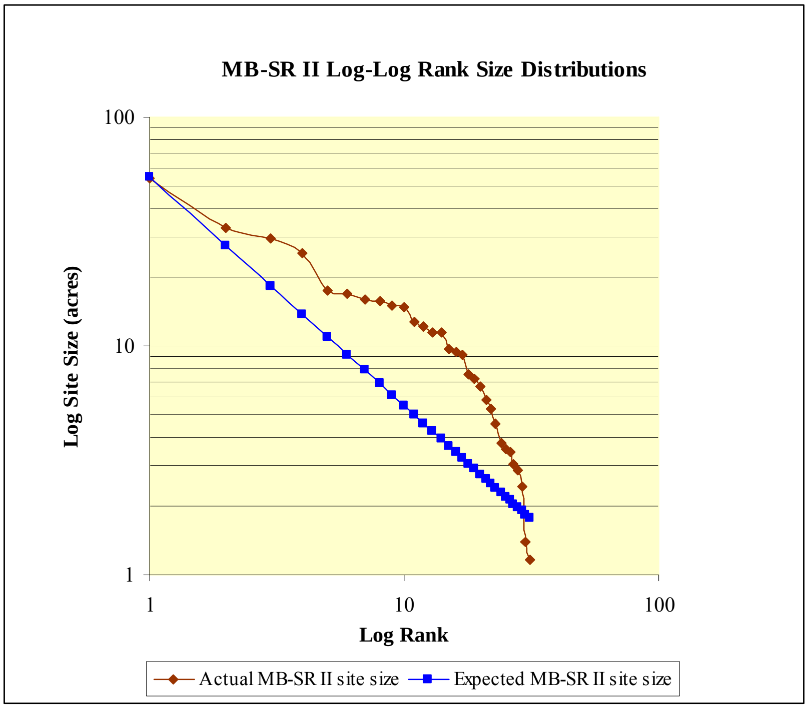


Figure 37. Log-log rank size distributions of St. Croix's Magens Bay — Salt River II sites, by time period and cultural affiliation.

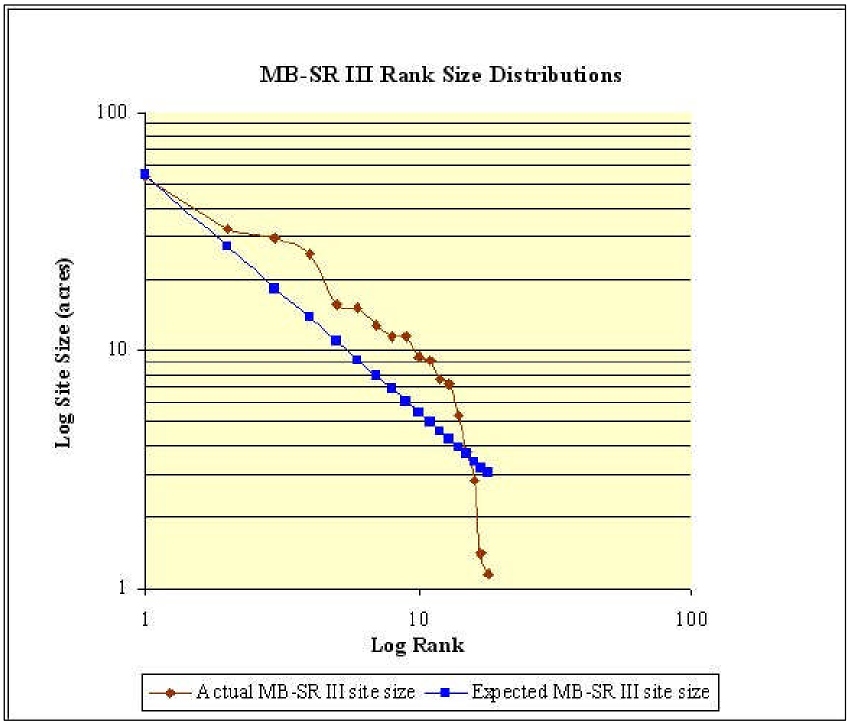


Figure 38. Log-log rank size distributions of St. Croix's Magens Bay — Salt River III sites, by time period and cultural affiliation.

Table 20. Site sizes and soil types for MB-SR III phase sites.

Name	Site #	Rank	Size (acres)	Soil Type	Name	Site #	Rank	Size (acres)	Soil Type
Pleasant Valley	63	1	54.30	Ac	Punnett Point	20	11	9.16	Gy/Vs
Sprat Hall, Sprat Hole	12	2	32.69	Ac	Concordia Ridge 2	301	12	7.54	Vs
Fair Plain	10	3	29.63	Gy	Cramer Park	17	13	7.23	Gy
Work and Rest	304	4	25.50	Ar	Beauregard Bay	3	14	5.33	Vs
Cane Bay	7	5	15.72	Gy	Concordia Ridge 1	95	15	3.76	Vs
Richmond	4	6	15.02	Gy	Solitude	18	16	2.85	Gy
Bonne Esperance	303	7	12.71	Vs	Fair Plain 2	35	17	1.40	Gy
Manchenil Bay	40	8	11.48	Gy	Pull Point	19	18	1.16	Sr
Halfpenny Bay	21	9	11.45	Gy	Hartman	76	19	1.16	Gy
Salt River	6	10	9.42	Gy/So					

Note: abbreviations for soil types are as follows. Ac=Annaberg-Cramer, Ar=Arawak, Cv=Cramer-Victory, Gy=Glynn, So=Solitude, Sr=Southgate-Rock, Vs=Victory-Southgate.

Table 21. K-values for actual and least squares regression of rank size distributions (assuming 75 percent coverage), Magens Bay — Salt River III sites.

K-value, Monte Carlo simulation, 10,000 runs, actual data	0.333, where Q=1
Description Monte Carlo simulation, 10,000 runs, actual data	Simulated K-value equaled or exceeded the actual value 0 times in 10,000 runs. The estimated probability of drawing a sample of 18 sites with the observed k-value from a log-normal distribution is < 0.0001. There were 18 * (1 / 0.75) = 24 sites in the simulated universe.
K-value, least squares regression	0.222, where Q= -2.207
Description of K-test, least squares regression	Simulated K-value equaled or exceeded the actual value 10,000 times in 10,000 runs. The estimated probability of drawing a sample of 18 sites with the observed k-value from a log-normal distribution is 1. There were 18 * (1 / 0.75) = 24 sites in the simulated universe.

The rank size analysis appears to demonstrate several incarnations of convex and double-convex curve variations to the rank size rule. During the Prosperity phase of the Early Saladoid period, there was likely little hierarchical organization of settlements, with the possible exception of the Glynn and Windsor sites; this phase demonstrates a convex curve variation as defined by Savage (1997). During the Coral Bay — Longford phase, settlements appear to be organizing hierarchically, the majority of which are between 10 and 20 acres in size. This pattern continues into the Magens Bay — Salt River I and II phases.

All the cultural phases following Prosperity demonstrate a double convex curve variation to the log-normal rule. This is interpreted as the likely presence of two or more forms of settlement systems existing in the same area, or a central place-like system was beginning to develop; a classic central place settlement system will demonstrate a stair step distribution (Savage 1997).

There are several problems with this analysis, most of which stem from the assumptions listed above. First, the single site that is reportedly over 50 acres in size, Pleasant Valley/Mount Victory, has only been described on the basis of a pedestrian surface survey and has never been systematically archaeologically tested. The site's large size could be indicative of large populations that grew and moved across the area, or from several smaller but possibly related households that moved across the landscape over time. The size of the surface scatter of artifacts could also have been the result of both site formation processes and the effects of over 200 years of cultivation and plowing by European colonists, distributing artifacts located in the plow zone across the landscape.

Second, there is not enough data available to reliably estimate ancient populations for St. Croix. A house has not been completely excavated on the island, nor has an entire site. Population estimates based on the number and area of settlement will be obtained as part of future research.

Finally, the results of the least squares regression for the Magens Bay — Salt River III sites indicate a possible sampling error, due to the fact that either not all sites for this phase have been identified, that their sizes are inaccurately estimated, or that many may have been destroyed.

On the other hand, this analysis does provide insight into the general number of sites across the island identified to date, their estimated sizes, and their distributions in relation to locational preferences and potential interpretation for definitions of socio-cultural value and meaning.

Path Distance Analysis

In order to shed further light on the nature of possible intersite relations, a path distance analysis was conducted for all sites based on their chronological affiliation, using ESRI's Spatial Analyst program for ArcGIS 9.2. In short, the path distance calculates the minimum accumulative costs to travel across a surface from one point to another, while compensating for the actual surface distance and horizontal and vertical factors (slope). First, hydrology, basins, and regions were determined using slope information (Figure 39). Drainages were defined based on regions of streams. Even though today there is no running water on the island, Salt River was a perennially running stream until 50 years ago, and Spanish and French maps dating to the middle of the seventeenth century depict at least three "rivers." It is therefore assumed that prior to the removal of forests on the island by European settlers there were numerous small rivers, streams and brooks that were both perennial and rain-fed.

Next, slope and elevation were used as the most weighted variables regarding site selection and location (Figures 40 through 44). It is assumed that regular lines of communication and interaction between communities (nodes) will follow the shortest paths of least resistance (links), and in this case, generally follow the hydrology along streams and watershed networks.

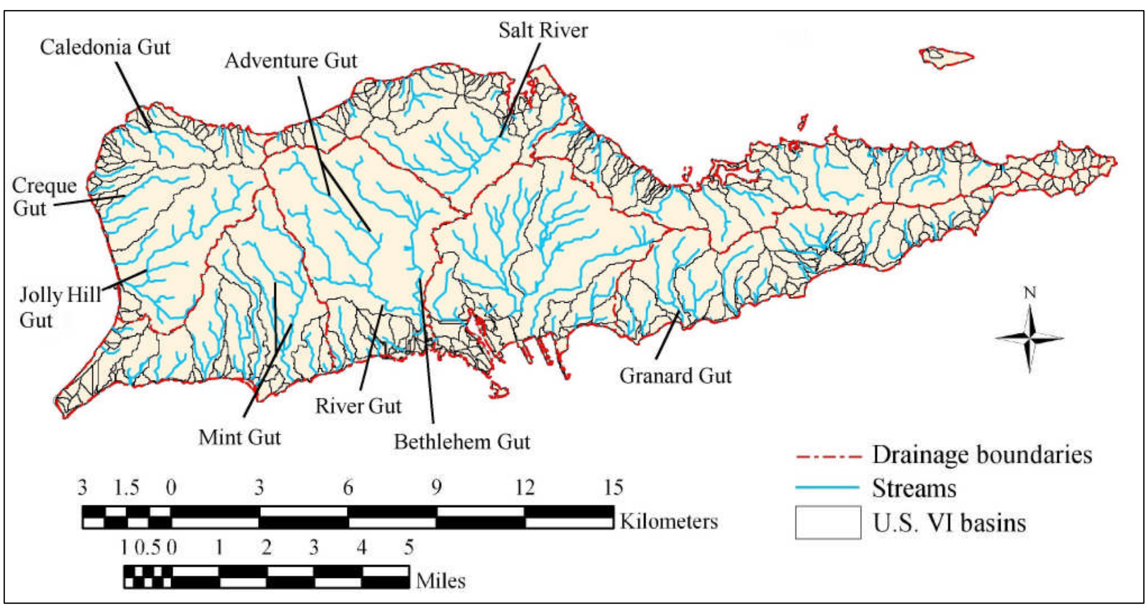


Figure 39. Hydrology, with drainages and basin boundaries, for St. Croix.

During the Prosperity phase, one settlement is established in each drainage system; four settlements are established at the mouths of streams and guts (Richmond, Great Pond, and possibly Limetree Bay), while four were placed in the Coastal Plain (Prosperity, Longford, St. Georges, and Glynn/Windsor). In the Salt River drainage, the Salt River and Glynn/Windsor sites were likely related, as they were located along the same waterway, Glynn/Windsor being upstream in the upland-inland region. The Prosperity, St. Georges, Glynn/Windsor, Longford, and possibly Limetree Bay (depending on its actual location) settlements could have been linked via overland routes that would have been of low travel cost even though these paths would have cut across drainage systems. The Salt River, Richmond, Great Pond, and Limetree Bay sites would have been accessible by canoe, following the coastline.

By the Coral Bay — Longford phase, additional settlements were established at the mouths of streams, while interior settlements were located upstream, one near the headwaters, and one further downstream at the conjunction of the primary stream and a tributary. These streams constitute the least cost paths between these settlements. The majority of new interior settlements were established in two drainage systems: the northwest mountainous region (Creque Gut — Jolly Hill Gut drainage systems) and the Salt River system, where new settlements were established on the ridges overlooking the Salt River site and the north coast. These settlements were likely linked by overland routes that met at strategic locales, namely the St. Georges and River sites. The settlement at the River site, located at the juncture of Adventure Gut with a tributary, was likely related to a settlement at the head of Adventure Gut (the Fountain site). New coastal villages were established in the previously unoccupied northeast drainage (Cotton Valley system), while three new settlements were established in the Great Pond system. There may have been additional communities located at the heads of other streams that did have a settlement at their mouths, but at the time of this writing they have not been identified. The overland least cost paths that were established during the Prosperity phase remain, while the majority of new coastal sites were likely connected to each other via water routes that followed the coast. The cays begin to be used, presumably by communities on the northern half of the island though they could have been accessed by anyone with the means.

There are few new settlements established during the Magens Bay — Salt River I phase; those that are established appear along the projected least cost paths connecting northern and southern settlements. The concentrations of settlements continue to be focused on two drainage systems, the northwestern drainage (that included both Creque and Jolly Hill Guts) and the Salt River drainage, that continued to be connected via inland hubs at the St. Georges and River sites.

The eastern half of the island's coast continues to see growth and these settlements appear to be connected along linear paths following the coast, and the cays continue to be used.

During the Magens Bay — Salt River II phase the number of settlements decreases, while a new hub (the Fair Plain site or cluster of sites), is developing at the confluence of Bethlehem and River Guts. The "gap" that existed between the northwestern and Salt River settlement groups appears to be infilling with new, small settlements that may have acted as nodes connecting these two regions, and the growing Fair Plain settlement may have been this region's central hub. The Prosperity settlement has been abandoned, and is possibly replaced by Sprat Hall (12VAm1–12) as the node connecting the northwestern communities. The eastern settlements continue to be occupied, all of them having only two or three links to other communities.

Finally, the decrease in the number of settlements during the Magens Bay — Salt River III phase could have been the result of people moving to better-connected communities like Fair Plain, Sprat Hall, and Salt River. While the island's eastern communities continue to be occupied and linked to each other linearly, the other drainages, once filled with both inland and coastal settlements, now have only one or two communities each. The Salt River system retains three ridge-top sites, but their roles as either upland villages, lookout posts, or some other function remains unknown. There is no longer evidence of the cays being used, but this evidence could have been erased by erosion, storms, or other natural or cultural (i.e. historic colonial) actions.

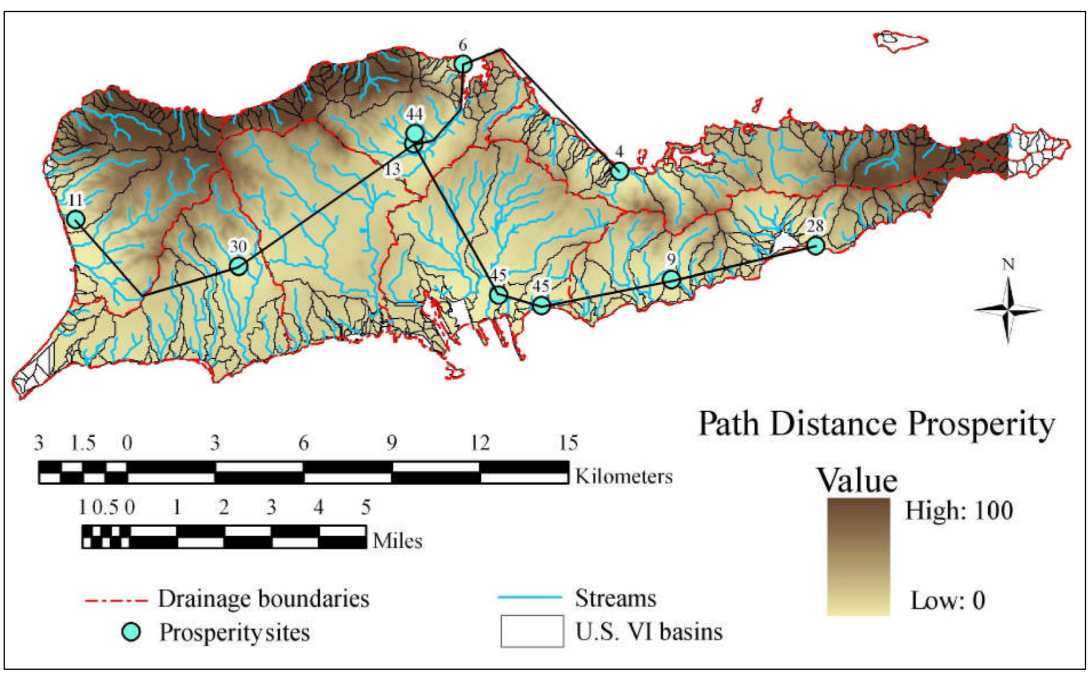


Figure 40. Path distance analysis, with drainages and basins, for all Prosperity sites.

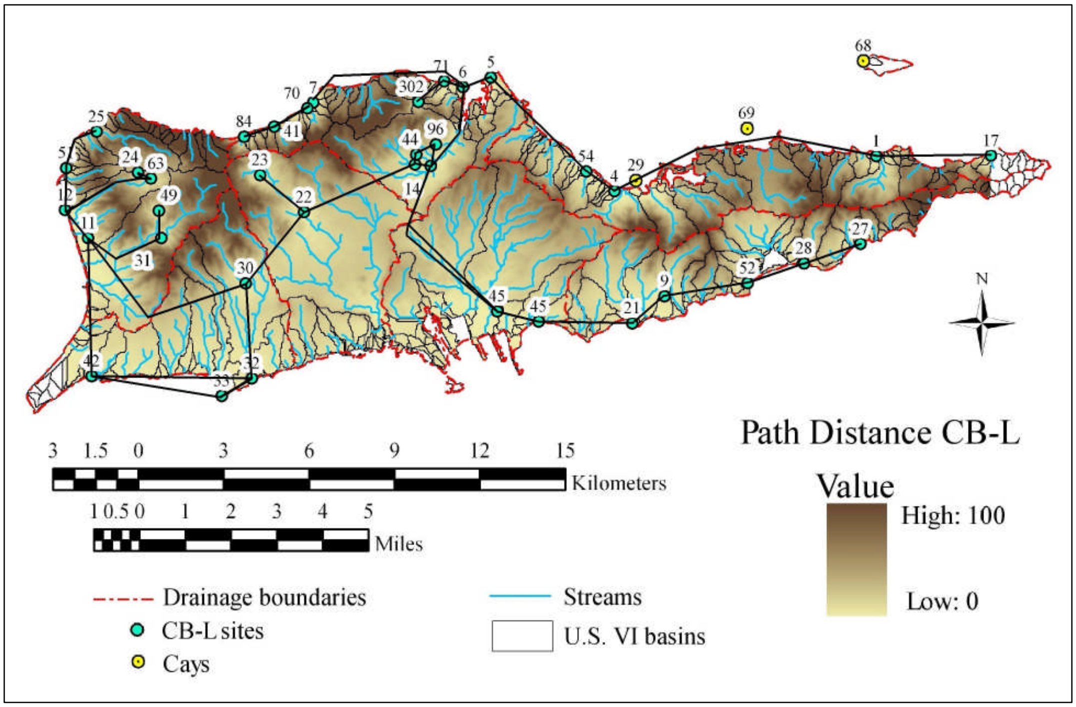


Figure 41. Path distance analysis for all Coral Bay — Longford sites.

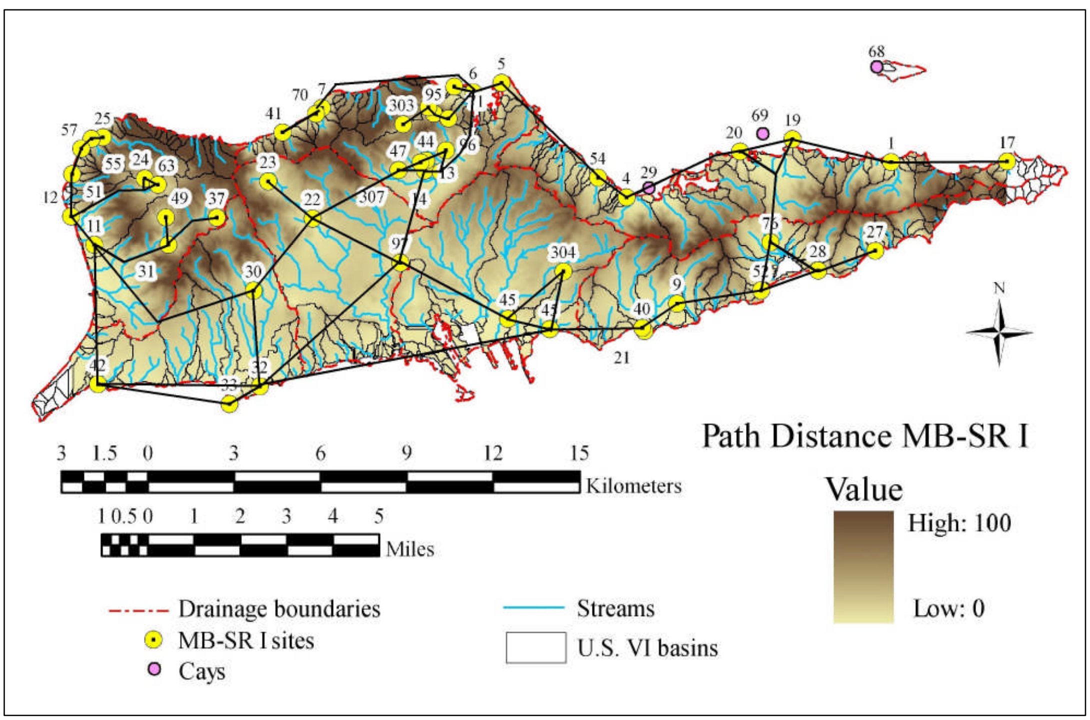


Figure 42. Path distance analysis for all Magens Bay — Salt River I sites.

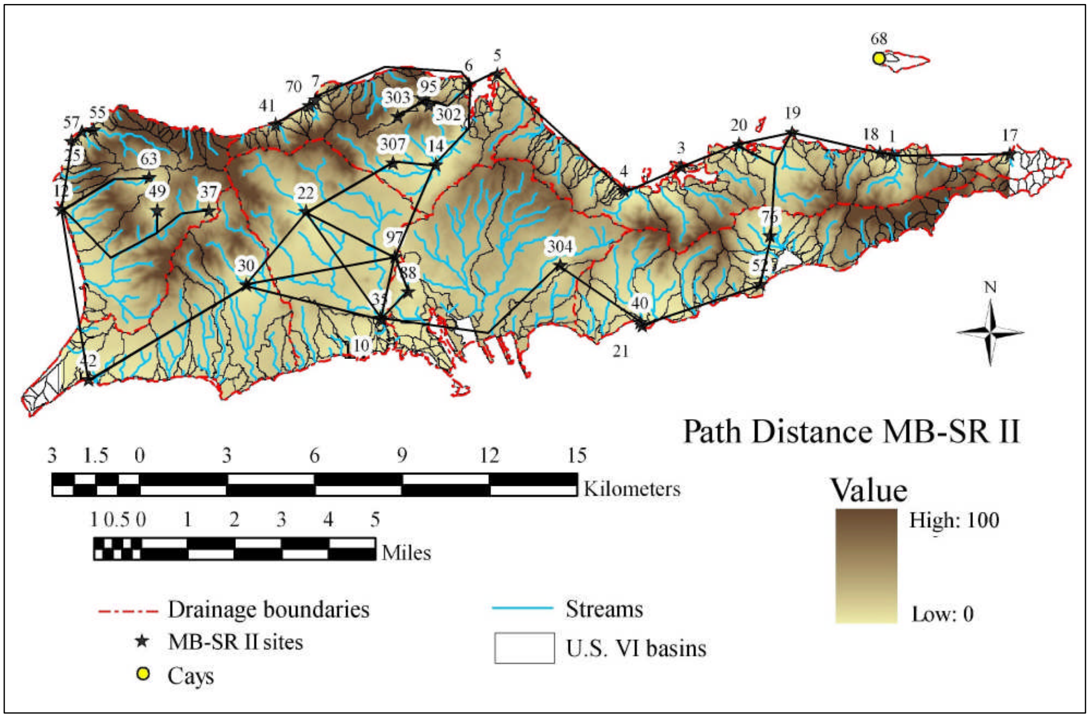


Figure 43. Path distance analysis for all Magens Bay — Salt River II sites.

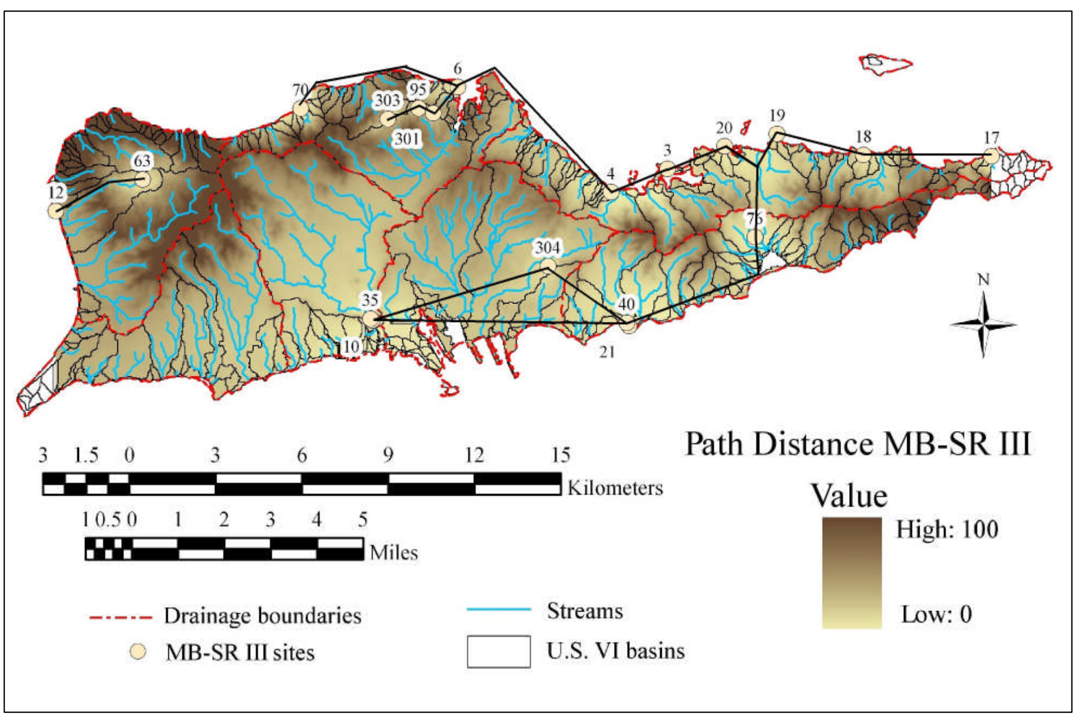


Figure 44. Path distance analysis for all Magens Bay — Salt River III sites.

In order to investigate the potential development of scale-free networks and small-worlds, nodes were connected to their nearest, most cost-efficient neighbors as determined by the path distance analysis. Some nodes were connected to only one other node, while others were connected to several (Table 22). While these connections were made using Euclidean distance, the paths chosen were the shortest measurable lengths within the corridors determined by the path distance analysis (see the black lines drawn on Figures 40 through 44).

The numbers of connections for each node are defined as follows: nodes with one or two connections are individual actors within a small interaction sphere. Those nodes with three connections are potentially small hubs within particular spheres. Those with four or more connections are larger hubs linking the smaller nodes (and their networks) to a larger network, and quite possibly with external networks that would represent long-distance relations. In other words, they are the strong links between the more weakly-connected developing small-worlds. These better-connected nodes will be the most likely locale for evidence of long-distance trade, presence of valuable goods, and possibly the scene of sacred and ceremonial ritual. They could also represent the locations of specialized production of particular goods. In comparison, nodes with only one or two connections could represent special use sites, like stone quarries, garden plots, or even look out posts.

The majority of settlements in all time periods have two connections, with the exception of Magens Bay — Salt River III communities, in which most settlements have three low-cost links. For all time periods, the most connected nodes in the system, those with four or more links, are the fewest in number but are not necessarily the largest in regards to site size. Until the Magens Bay — Salt River II phase, the most connected sites were in the upper half of all sites in relation to size, ranking numbers 9, 11, 19, 21, and 26. It is not until the Magens Bay — Salt River II phase when one of the largest sites, Fair Plain (12VAm1–10, 35, and 94, ranked third) is also one of the most well connected.

Based on this analysis, the Prosperity phase settlements do not appear to be connected to each other via terrestrial links; most of these communities are potentially connected to only one other settlement. It is possible that most of these sites ties are likely oriented toward off-island settlements. However, by the Coral Bay — Longford phase not only are these settlements linked to each other, but they appear to be developing into hubs connecting growing small with intra-island networks, primarily in the Salt River, north central, and northwest regions of the island. These better-connected hubs are the Prosperity, River, and St. Georges sites.

Table 22. Number of potential connections between sites, per time period.

Time Period	*1 Connection*	*2 Connections*	*3 Connections*	*4 or more*
Prosperity Total	2	5	2	0
Territorial Site #s	11, 28	4, 6, 9, 30, 45	13, 44	
CB-L Total	8	17	6	3
Territorial Site #s	17, 23, 25, 27, 49, 71, 84, 302	1, 4, 5, 7, 9, 21, 24, 28, 31, 33, 41, 44, 45, 51, 52, 54, 63	12, 13, 14, 32, 42, 96	11, 22, 30
MB-SR I Total	9	17	16	4
Territorial Site #s	17, 23, 25, 27, 37, 41, 49, 71, 303	1, 4, 7, 9, 19, 20, 24, 33, 51, 54, 55, 57, 63, 95, 301, 302, 307	12, 13, 14, 21, 28, 31, 32, 40, 42, 44, 45, 52, 76, 96, 97, 304	6, 11, 22, 30
MB-SR II Total	7	19	4	3
Territorial Site #s	17, 25, 37, 41, 49, 63, 303	1, 3, 4, 5, 7, 18, 19, 21 (40), 42, 52, 55 (57), 76, 88, 95, 301, 302, 304, 307	12, 14, 20, 97	6, 10/35/94, 22, 30
MB-SR III Total	5	4	7	3
Territorial Site #s	7, 12, 17, 63, 303	3, 4, 18, 304	19, 20, 21, 40, 76, 95, 301	6, 10/35

Note: all coastal sites may be connected to each other. This table provides potential connecting relations between neighboring coastal sites and inland sites. Cays are considered resource extraction and camp sites, and are not included on this table.

This pattern continues into Magens Bay — Salt River I, where the majority of nodes have two and three links (17 and 16 each, respectively). It is during this time that the Salt River site joins the other hubs in the number of potential connections. During the Magens Bay — Salt River II phase there is a drop in the number of communities with three low cost links, and an increase of those with only two. However, the Fair Plain site becomes a large hub, potentially connecting nearly every drainage system across the island. The Salt River site continues to be well connected, and could have been a "jumping off point" for interisland communication and interaction. The number of well-connected nodes is decreasing while the number of smaller, less-connected nodes increases. Finally, there is an apparent breakdown in the network during the Magens Bay — Salt River III phase, where only the Salt River and Fair Plain settlements have more than three possible links, possibly indicating the division of the island's population into two political regions centered at these communities. Both of these archaeological sites have produced either fragments of or complete stone collars and ceramic wares with decorative elements similar to the Boca Chica and Capá styles of the Dominican Republic and Puerto Rico, as will be discussed in Chapter 5. The St. Georges and River sites, on the other hand, are finally abandoned.

To review, scale-free networks are complex, in which vertices (nodes) are connected by links that represent interactions (Barabási et al. 2000; Strogatz 2001). These networks are complex, open, and dynamic, with new nodes being continually added into the system while others disappear. The links between nodes in the network are also preferentially connected, with a higher probability that new nodes in a network will attach to other nodes that are already well connected. They have relatively short average path links and higher clustering coefficients (Table 23); the clustering coefficient is the "quantification of connectivity among immediate neighbors of i (node)" (Savage 1997; Wang and Chen 2003). The formula for the clustering coefficient of i node (cc(i)) is:

$$cc(i) = 2\,(e(i) / n_1(i)(\,n_1(i) - 1))$$

where e(i) = the number of connections observed among neighbors of n_1, and n_1 = number of immediate neighbors.

For this study, the average distance between sites on St. Croix was determined for each time period by using a nearest neighbor analysis. While this form of analysis uses Euclidean distance (a straight line between two points, regardless of horizontal and vertical factors), it does provide a basic value regarding distance between sites.

Table 23. Clustering Coefficients and Average Path Lengths, St. Croix archaeological sites.

Time Period	*Clustering Coefficient*	*Average Path Length (m)*
Prosperity	0.1667	6563
CB–L	0.1248	1538
MB–SR I	0.1139	1360
MB–SR II	0.0896	1572
MB–SR III	0.0585	1865

As presented in Chapter 3, the climate for St. Croix toady is dry and subtropical, and for the last 50 years there has been no perennial water flow of streams or rivers on the island. Observations made by French settlers and cartographers during the seventeenth century noted the presence of at least three, and most likely four, rivers or major streams on St. Croix, all located in the Northside Range: Creque Gut, Mint Gut, Caledonia Gut, and Salt River. Today, these four major streams flow only intermittently during periods of heavy rainfall. It is not known if the majority of other smaller streams and tributaries would have been primarily rain-fed or perennial; regardless, even during periods of drought a dry streambed would be easy to traverse between communities along the same watershed. The larger streams and rivers could have been accessed via canoe (traveling downstream) or by trails paralleling waterways for upstream treks. That being said, the cross-country least cost paths were determined through the use of slope and elevation, the majority of which were located in the coastal plain with little variance in elevation. The small size of the island — roughly 20 miles long by five miles wide — reduces the effect of size and distance when considering cross country links to various nodes; on the other hand, the island's high relief is a determining factor for efficiency.

Comparisons to Neighboring Islands

There have been several regional settlement pattern studies conducted across the Caribbean (Haviser 1997; Rouse 1952; Walker 1983). In this section I only discuss three studies conducted in the Greater Antilles.

In 1983, Jeff Walker, working with the Investigaciones Arqueológicas del Caribe, conducted a preliminary archaeological survey of the Guayanés River system located in southeastern Puerto Rico. The purpose of this survey was to locate and identify archaeological sites based on a predictive model of site location and settlement pattern; this model assumed that archaeological sites would be located near rivers and their tributaries, and that larger sites would be more strategically located near river confluences and reliable resources (arable soils, sources of stone, etc.) Only 23.4 percent of the study region was covered, using pedestrian surface survey, examination of exposed river banks, and perusal of the archaeological site files and maps locate in the State Historic Preservation Office of Puerto Rico.

Seven archaeological sites were identified; two were located at the mouths of rivers, one was located on a terrace or hill above an inland river and near a confluence with a tributary, and one was located on a terrace or bench overlooking a floodplain, again near a confluence. This last site was the largest encountered, and had evidence of human burials. Two sites that had been reported to the survey team by local informants were not relocated, but artifacts were observed in the stream beds nearby; these sites were hypothesized to be located on terraces overlooking nearby streams, and were likely buried under deep alluvial deposits if not destroyed. Finally, a petroglyph site was located on a boulder sitting in the middle of a stream. These petroglyphs faced downstream toward another area reported by locals to also have rock carvings; this second area was not located.

Curet's study (1992, 2005) of settlement patterns in three river basin regions (Loíza, Salinas, and Yauco) across Puerto Rico and Vieques revealed patterns that are similar to those on St. Croix. In short, for the Loíza and Salinas River valleys and Vieques during the Early Saladoid period, settlements were large and located at coastal and low lying areas. By the end of the period the number of settlements was increasing, especially smaller sites in inland areas. This pattern continued into the Early Ostionoid, but during the Middle Ostionoid these regions' patterns began to diverge. In Loíza, the increase in numbers of sites occurs first in interior intermediate areas, then in both low lying and high elevation areas. By the end of the Ostionoid period there was a slight decrease in the numbers of sites, especially medium-sized settlements. Large sites were surrounded by smaller sites.

There was a substantial increase in the number of settlements in the Salinas Valley during the Early Ostionoid period, primarily of hamlets and small villages. The number of ceremonial centers with monumental architecture increased as well, especially in the foothills. By the end of the period there was a large depopulation of the region, with many of the small village and hamlet settlements being abandoned as well as all but one ceremonial center (Curet 2005:135-136).

On Vieques, the number of coastal sites (primarily small hamlets and camps) increased during the Early Ostionoid period while the number of village settlements increased during the Middle Ostionoid. By the end of the period a few settlements had been abandoned. All camp sites were located on the coast.

The patterns of the Yauco River Basin varied slightly from those described above. All of the Saladoid period settlements were located in the coastal plain, with smaller sites located closer to the coast. This pattern continued throughout the Ostionoid period, and included both villages and hamlets. There was no evidence for a centralized pattern of settlement, as in Salinas, and no evidence for any form of monumental architecture.

Additionally, Curet (2005) tested theories of how increasing populations could potentially place stress on natural resources, as evidenced by increasing number of sites within a given region. Population estimates were developed for the Valley of Maunabo, and were compared to the potential carrying capacities for the valley by using estimated calories per kilogram and average annual yield rates for both manioc and maize. Curet found that though populations grew during the Cuevas and Santa Elena phases of the Late Saladoid and Early Ostionoid periods, there was not an apparent increase during the Monserrate phase (Middle Ostionoid period). By the Esperanza phase of the Late Ostionoid period, there was an apparent decline in the number of settlements across the region. The minimum carrying capacity for maize was possibly reached only during the Santa Elena phase, and the minimum carrying capacity based on a reliance on manioc was not approached (Curet 2005:177).

A settlement pattern analysis for prehistoric sites across northern and western-central coasts of Haiti was conducted by Koski-Karell (2002), who categorized archaeological sites into types based on site size and area. There are no known Saladoid period archaeological sites on Haiti, but there are Lithic and pre-Arawak occupations as well as Ostionoid period settlements. Koski-Karell found that patterns of settlements during the Ostionoid period were similar to those found on Puerto Rico, and St. Croix. That is, the Early Ostionoid settlements (during the Ostionan phase) were located along the coast or coastal plain, or were on Tortue Island (a xeric cay located 10 km off Haiti's north coast). These sites would have been easily accessible by canoe, and not likely connected via overland routes; they were located in three clusters which were roughly 50 km, about the distance that can be paddled in one day, in one direction.

During the subsequent Meillacan phase, a hierarchy of settlement types is observed. The majority of people continued to live in small and medium-sized villages on the coastal plain and coastal areas while some (roughly 40 percent of the total number of sites for this phase) also began to occupy the interior uplands (what Koski-Karell terms River Valley, Piedmont, Highland, and Montane zones). More of the small and medium-sized villages were located on the coast and coastal plain when compared to inland areas (67 percent vs. 33 percent). The majority of all sites during this period (92 percent) were households, hamlets, or small villages, with fewer sites as their sizes increase.

During the Chican phase (Late Ostionoid period), the majority of all settlements are located either in the northeastern part of the study area, or on Tortue Island. The majority of the smaller sites (households and hamlets) were located in upland areas while the larger settlements were on the coastal plain or on the coast.

Interestingly, the settlement patterns for both the earliest Lithic and the Arawakan Ostionoid period were similar, in that communities were located in both coastal and inland and upland areas. Koski-Karell goes on to state that, unlike Rouse's Cultural Seriation Model, that there appears to have been some overlap between these phases. The Ostionan cultures were not necessarily replaced by Meillacan cultures, and so on. In fact, there was likely interaction between the descendents of pre-Arawak populations and Ostionoid peoples, which may have led to the rise of institutionalized hierarchical social systems across the island.

The patterns determined for Salinas, Vieques, and Loíza and for northern Haiti are similar to those presented in this chapter for St. Croix. All of the Early Saladoid period settlements were located either on the coast or in the coastal plain, and by the end of the period settlements were being established both in the plain and in inland, hilly and mountainous areas. All of the Saladoid period settlements continued to be occupied during the Early Ostionoid, but by the Middle Ostionoid (Magens Bay — Salt River II) several of the older sites were abandoned and a few newer settlements established. By Magens Bay — Salt River III phase, the number of settlements had dropped dramatically, 54 percent, which could be explained in several ways. The island's residents moved to particular centralized villages, where they participated in the Late Ostionoid cultural sphere that would have spread from Hispaniola to Puerto Rico to the islands of the northern Lesser Antilles. Likewise, these peoples could have moved off island in large numbers for a variety of reasons.

Finally, and according to local tradition, they could have been attacked by arriving Island Carib populations, who reportedly killed the men and took the women and children as wives and slaves just prior to the arrival of Columbus in 1492; these groups then went on to conduct raids on other nearby islands (including Puerto Rico). However, even though there is little archaeological evidence that supports this tradition, there are several possible explanations for this absence: the evidence could have been destroyed during the colonial era or later agricultural and land moving endeavors, their cultural materials could have been misidentified as Late Ostionoid utilitarian or plain wares and tools, or they did not live extensively on the island. Based on four written accounts from Columbus' encounter with these peoples on 14 November 1493, they closely resemble people that were encountered at Golfo de las Flechas (Bay of Arrows) Semaná, Hispaniola, during Columbus' first voyage; these people were not called "Caribs" but *Ciguayos*. They had stained their faces and eyes black, wore no clothing, and wore their hair long and tied back with feathers. Only one of the four accounts of the incident at Salt River calls the people "Caribs." It is interesting to note that early historical accounts state that there were roughly 20 villages on the island during the early European colonial era, and that there are 19 confirmed Late Ostionoid or Magens Bay — Salt River III sites identified to date.

SUMMARY

The landscape is imbued with history, meaning, and value. The placement of houses and villages, their alignment, and location are interpretable as physical realizations of beliefs, value, and status. Spatial relations, both within and between communities (and archaeological sites), can be analyzed to study the activities, beliefs, and behaviors of those who created them (Kolb and Snead 1997). The placement of settlements on the landscape is also indicative of societal organizational strategies. Site selection, building placement, patterns of settlement, and architectural style are not only pragmatic choices but are material insights into worldviews and cosmological principles of order and structure. These principles and worldviews are demonstrated by objects held in prestige, regarded with value and even considered sacred, and the status of the individuals responsible for their creation and transportation in addition to those who obtain the finished item. Conceptions of heterarchy as realized on the landscape are applicable, in that, as described in the Introduction, economic specialization and political hierarchies are not necessarily connected, and do not consequently develop into a single system (i.e. central place settlement hierarchies, where economic, political, and ideological control are concentrated in a single seat of power). As presented by Rogers (1995:8), many people can have and grant access to resources located in a variety of places across regions.

In this chapter, the basic theoretical paradigms most utilized in settlement pattern analyses were summarized. A brief overview of the history of archaeological survey and investigation on St. Croix was presented, and the results of over 100 years of pedestrian surface survey, testing, excavation, and reevaluation with site descriptions for the entire island's known and verified archaeological sites dating to the Saladoid period were summarized. A settlement pattern study that utilized horizontal and vertical variables in a GIS was then presented, and tracked diachronically. Finally, using a rank size distribution for all sites chronologically and a least cost path/path distance analysis, a model for interisland interaction was constructed.

The results of the GIS analysis can be interpreted in the following way. St. Croix's prehistoric communities were strategically established along paths of transportation and communication. Over time, and as village populations grew, hilltop residences were established that were quite possibly defensive locales, especially on the hills above Salt River Bay. The initial settlements on St. Croix were established in areas where lowland Amazonian and Orinoquian lifeways could be continued; that is, horticulture and gardening, with easy access to the seashore for fish, crabs, and other marine resources. These settlements also likely included a territory that encompassed an entire drainage system, the only exception being those in the Salt River system where both a coastal and inland communities were established. These drainage systems could have acted as political boundaries, and particular villages located in key locales could have risen in importance and developed into new hubs of interaction in growing localized interaction spheres, (or small-worlds). Over time, new villages developed quite possibly at interior garden plot locations. The initial places of settlement, however, remained important as centers that fostered the continuation of Saladoid-era beliefs and practices, indicating membership within the Arawakan interaction sphere.

Based on the above analyses, the greatest changes apparently occurred at the end of the Prosperity phase, when links that had been focused on interisland and long distance relations likely began to transition toward intraisland interactions. This does not mean, however, that these Early Saladoid period societies were "egalitarian," but they could have been part of an expansive regional system that, as with many other island societies that spread and colonize new areas, carried the values and beliefs of the homeland to these new areas where they were maintained for a period of time. It is posited that the primary break in social organization and symbolic value occurred by ca. A.D. 600, at the end of the Late Saladoid period. These changes are not indicative of a cultural "dark age," but a dynamic era where new values evolved from old, and where new ethnic and social identities were developing out of local historical pasts and experiences of the present.

Relationships between settlements along watersheds and drainages can also be presumed, where communities at the shoreline or entrance to watersheds (in the alluvial fan) tend to have been established earlier than those further inland, with the exception of the Salt River drainage**.** This could be the result of increasing needs for production of staple foods, increasing populations, the gradual learning of the productivity of local soils and microenvironments, and the discovery of a variety of other resources, such as fresh water, stones for making tools, and trees for making canoes. These interior settlements could have had relations with coastal communities, trading or exchanging crops for fish, shellfish, or other goods. These interior settlements could have also been the garden houses of coastal groups occupied during periods of planting and harvest.

It also appears that the settlement pattern follows, in many ways, Vance's Mercantile Model, and that by the Magens Bay — Salt River II phase a central place system was beginning to develop around the Fair Plain site. This is supported by both the rank size distribution and the GIS analysis, which demonstrated that, with the exception for the Prosperity phase, there were likely two or more forms of settlement occurring across the island simultaneously. However, only future research and systematic excavation will be able to prove this model.

Some of these communities (Cane Bay, Judith's Fancy, Salt River) have demonstrated two forms of interment practices: primary, articulated and flexed burial, and disarticulated burial in middens, possibly as a secondary practice. Some of these remains have evidence of being burned or exposed to high temperatures with little evidence of twisting fractures that are indicative of burning with the skin still attached, meaning that the skin was likely removed and the bones allowed to dry prior to cremation. Additional testing is needed at many more sites across the island in order to assess the validity of these patterns, but it is noted that dual forms of interment have been noted on other islands (Budinoff 1991; Crespo Torres, E. 1991; Rodriguez Ramos 2007; Sandford et al. 2002). The placement and patterns of these burials, such as gender segregation and proximity to the centers of plazas, have been noted in very few studies, and have the potential to reveal much about the internal social structures of these societies.

It is recognized that the use of a physical boundary between land and water — the island — is an artificial construction. As stated earlier, definitions of self and group identity go beyond apparent borders of land and sea, and there were likely connections and interactions between communities of various islands, as will be demonstrated in the following chapter. A regional scale study following the methods used in this chapter would demonstrate both local and regional degrees of societal integration (or divergence) and interaction, through the addition or disappearance of nodes and links throughout the network.

In the following chapter, I present an analysis of particular material goods often traded through these interaction networks, elaborately decorated ceramics, and stone objects made of nonlocal stone, all of which date to the Saladoid period.

CHAPTER 5

ST. CROIX CERAMIC AND STONE STUDY

INTRODUCTION

In this chapter the material culture and results of specific studies of Crucian archaeological materials is discussed. Specifically, the results of a three-part study of ceramics and prestige stone ornaments from archaeological sites on St. Croix that date to the Prosperity to Coral Bay — Longford to Magens Bay — Salt River I periods are presented. First, I present a preliminary, qualitative study of collections of artifacts from Crucian archaeological sites housed in five institutions across the United States and Europe. Second, the results of a preliminary comparative geochemical compositional study of samples of ceramic sherds and local clays that could have been used to make these ceramics are analyzed and discussed. Finally, the results of a geochemical analysis of polished stone celts and carved stone ornaments and beads from the Folmer Andersen Collection are presented.

As alluded to in the Introduction, little attention has been paid to the "fall of the Saladoid," a cultural transition that occurred ca. A.D. 400 – 600. This transition between Saladoid and Ostionoid periods was noted early in Caribbean ceramics as a stylistic change from well-made, uniform, and skillfully decorated wares to less elaborate decorations and variable technological quality of vessel production, demonstrating an increasingly localized differentiation. There has been little discussion concerning the internal processes of socio-political development, change, and adjustment over time as evidenced in ceramic styles, and the cessation of long distance exchange relations.

SALADOID TRADE AND INTERACTION NETWORKS

As more controlled, research-driven archaeological work has been conducted in the Caribbean our knowledge of the region's prehistory has increased. It is now possible to examine the distributions of goods, and the roles of these goods within spheres of circulation and interaction that connected the islands of the West Indies, Lowland Amazonia and Orinoquia, and even the Isthmo-Colombian region. For example, there is evidence for extensive circum-Caribbean and interisland trade networks among the early Saladoid cultures in the form of a far-reaching lapidary industry using exotic materials (Allaire 1997; Boomert 1987; Chanlatte Baik and Narganas Storde 1984; Cody 1990, 1991; Crock and Bartone 2000; Crock and Petersen 2004; Murphy et al. 2000; Righter 1997; Rodriguez 1991, 1997; Vescelius and Robinson 1979; Watters 1997; Watters and Scaglion 1994). These materials included finished beads, plaques, ornaments, and pendants carved from a variety of materials both native and non-native to the islands of the West Indies. These networks could have also included perishable goods that were known to have been exchanged between different cultural groups throughout the Orinoco and Amazonian regions, such as foods, feathers, and baskets (Boomert 2000a; Gasson 2000; Hornborg 2005).

Likewise, the continuity of ceramic series and styles for roughly 500 to 1,000 years, including WOR and ZIC wares, is not merely representative of the physical movement and diffusion of people that were then remained static until influenced by external forces (entrance of new societies into the region, environmental changes, etc.) Instead, it is indicative of broad networks of interaction, communication, and exchange of information and goods that maintained and perpetuated knowledge and traditions of methods of pottery production and decoration. Additionally, they represent continued efforts of maintenance and “passing down” of knowledge of long distance networks of resource acquisition. Over time, there was a gradual divergence of series and styles into regionalized traditions that developed within growing local and regional interaction spheres.

Stone Networks

Islands with stone beads and amulets, whether finished, in various stages of being worked, or still in the “raw ” state include Puerto Rico, Vieques, St. Croix, Montserrat, St. Kitts, St. Martin, St. Eustatius, Guadeloupe, Martinique, Nevis, Barbados, and St. Vincent (Figure 45) (Cody 1991; Watters and Scaglion 1994; Watters 1997; Crock and Bartone 1998). Of these, only a few sites have produced evidence for being manufacturing centers: Trants (Montserrat), Pearls (Grenada), Prosperity (St. Croix), Punta Candelero (Puerto Rico), and Sorcé (Vieques). There is also a brief allusion to some manufacture of stone beads, plaques, and amulets at Hacienda Grande, Puerto Rico (Rouse and Alegría 1990:66). Rouse and Alegría found that the most elaborate ornaments tended to be associated with the La Hueca series or style (Huecan subseries) of the Vieques Sound region, which included eastern Puerto Rico, Vieques, and the Virgin

Islands. Several sites from this area have been affiliated with the manufacture of beads and pendants, such as Sorcé, Punta Candelero, and Prosperity, indicating that the Vieques Sound could have been a specialized production region within the larger Caribbean Saladoid cultural sphere.

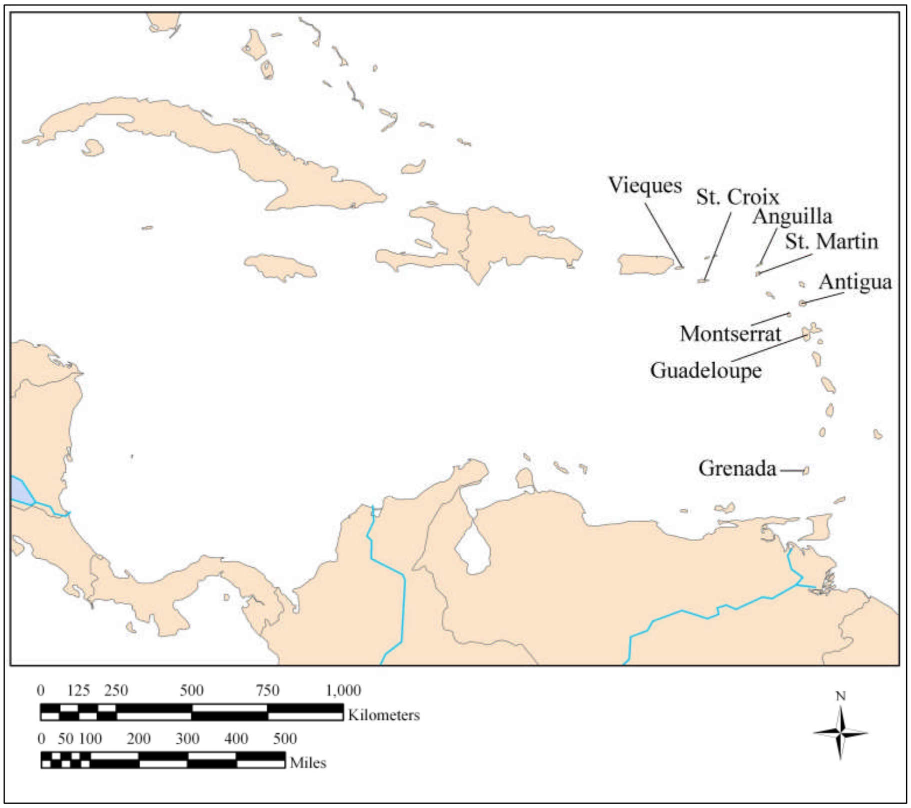


Figure 45. Map illustrating general distribution of Saladoid period non-local stone artifacts and materials across the Caribbean, as discussed in text.

The Trants site on Montserrat has long intrigued investigators. In 1924, Seymour Howes, a manager of the Trants Estate, began to donate his extensive collection of prehistoric artifacts he had amassed over the years (Watters and Scaglion 1994). The collection consists of over 1,000 objects, of which 548 were beads and related objects (bead blanks, raw materials) made of a variety of stones, including diorite, turquoise, amethyst, aventurine, limestone, rock crystal, nephrite, and carnelian; only 503 objects were available for study. The majority of bead blanks and pieces of raw material were carnelian (n=68, 12 percent of total of 503 studied artifacts), while the majority of all lithic materials was diorite (n=260, 53 percent) (Watters and Scaglion 1994:224). Archaeological testing was conducted in 1979 and 1990, which produced additional stone beads, bead blanks, and pieces of unaltered stone (n=113), again consisting of carnelian, diorite, amethyst, quartz, nephrite, and other types (Bartone and Crock 1991:127). Radiocarbon dating conducted during both periods of excavation placed the occupation of the site sometime between 2430 ±90 BP (480 B.C.) and 1620 ±90 BP (A.D. 330) (Petersen and Watters 1991:290). Because of the presence of carnelian in both raw and semi-completed forms and the fact that few pieces (less than one percent of the collection) consisted of completed carnelian beads, the site has been interpreted as a center of carnelian bead production. However, carnelian is not known to exist on Montserrat, so it is believed that raw materials were being mined from particular locales, transported to specific places of specialized production, then circulated as finished products throughout the Caribbean. The source of carnelian has not been identified. Additional evidence for the interaction of the Saladoid period peoples of Trants with groups on other islands included the presence of cobbles and pebbles of chert, most likely obtained from Long Island, Antigua, just 25 kilometers to the east.

Like the Trants site, the Pearls site on Grenada appears to have been a specialized production locus for particular kinds of beads and ornaments. Test excavations, conducted in 1988 and 1989, revealed evidence for bead production, including finished beads, bead blanks, chips, and raw stone, especially of amethyst and quartz. Additional types of nonlocal stone beads that were recovered included turquoise, nephrite, and carnelian (chalcedony) (Cody 1991:590-592). The site has been radiocarbon dated to 1914 ±51 BP (ca. A.D. 36) and 1711 ±74 BP (A.D. 239).

Two recently discovered archaeological sites on Antigua have also produced evidence for bead manufacture and production (Murphy et al. 2000). Archaeological testing at both sites, conducted in 1997 and 1998, revealed that bead and ornament production occurred at both the Elliot's and Royall's sites. A total of 642 specimens (Elliot's=149, Royall's=493) associated with ornament production were recovered, including raw pieces of carnelian, chalcedony, quartz, calcite, and barite (Murphy et al. 2000:239); identifications were made using scanning electron microscope (SEM) and/or X-ray diffraction (XRD). At the Royall's site, carnelian (n=45), quartz (n=13), and calcite (n=36) appear to have been the materials that were selected for production. The majority of finished beads at both sites were shell (aragonite or calcite; Elliot's=52, Royall's=181). Of the stone materials, the majority of finished beads were calcite (Royall's, n=18) and diorite (Elliot's, n=6). Two nephrite pendants were recovered from Elliot's, while only one was recovered from Royall's, in addition to a single turquoise bead. All of the stone materials, with the exception of amethyst, nephrite, serpentine, and turquoise are believed to have originated on Antigua. Because carnelian is naturally present on the island, there is the possibility that amethyst could also occur. Calcite (a.k.a. “dog tooth”) has been reportedly recovered from natural deposits on St. John’s, a cay off Antigua’s northeast coast.

Probably the most remarkable center of manufacture found to date is the La Hueca/Sorcé site, located on Vieques. Over 2,700 ornaments, including 1,400 frog and 40 raptorial bird pendants, were recovered in all stages of production (Chanlatte Baik 1983, 2003; Narganes Storde 1995a, 1995b). Stone types that were used include serpentinite, amethyst, peridot, aventurine, turquoise, rock crystal, opal, diorite, malachite, carnelian, and nephrite. The majority of stone objects were recovered in the eight middens associated with the La Hueca locus (or component) of the site, which was to the south of the Sorcé locus consisting of roughly 14 middens (Oliver 1999).

Like the Sorcé site, Punta Candelero (Puerto Rico) has two distinctive “zones” or areas of occupation that demonstrate different possible cultural affinities — Huecan and Cedrosan Saladoid — that include differential distributions of stone and shell beads and amulets (Boomert 2000a:438; Rodriguez 1991). The majority of these objects, both finished and unfinished, were encountered in the Huecan area.

As discussed earlier, the Prosperity site reportedly produced beads and amulets made of either turquoise or chrysocolla and possibly obsidian (Vescelius and Robinson 1979:2). Other stone materials recovered from Prosperity include both macrocrystalline (calcite, amethyst, aventurine, and bull quartz) and cryptocrystalline (carnelian, chalcedony, serpentine, hornblende, beryl, epidote, peridot, garnet, and “dog tooth”) quartzes. Additional evidence for the presence of stone materials brought to St. Croix from distant places is in the Andersen Collection. The collection includes numerous pieces of raw turquoise, malachite, amethyst, and carnelian, frog pendants, and other ornaments carved out of amazonite and green stones that resembles nephrite (Figures 46 and 47). Other stone objects include flake tools and debitage of chert, some of which resemble the flints of Long Island, Antigua, namely honey brown and dark gray flint with calcite inclusions (Figure 48).

Stone beads and amulets have also been recovered from a handful of human burial contexts. Saladoid period sites that contain burials with finished stone beads include Golden Rock, St. Eustatius (Versteeg and Schinkel 1992), Hacienda Grande, Puerto Rico (Rouse and Alegría 1990), Morel, Guadeloupe (Durand and Petijean Roget 1991), and Vivé, Martinique (Mattioni 1979). Stone beads were buried with some individuals at both Hacienda Grande and Maisabel. At Hacienda Grande, beads and amulets of amethyst, diorite, granite, milky quartz, and carnelian have been recovered during three separate archaeological investigations (Rouse and Alegría 1990).

Figure 46. Possible turquoise and malachite samples. Cat. # 827. Folmer Andersen Collection, Christiansted National Historic Site, St. Croix.

Figure 47. Examples of frog pendants. Top: left, cat. # 2017; right, cat. # 2021. Bottom: left to right, cat. #s 2022, 2018, and 2016. Folmer Andersen Collection, courtesy of Christiansted National Historic Site.

Figure 48. Chert and possible jasper flakes. Aklis site, cat. # 429532. Courtesy of the Smithsonian Institution Museum of Natural History, Washington, D.C.

In regards to exchange and lithic origins, the identification of turquoise beads from several of these Saladoid sites is problematic. The only known sources of turquoise are arid to semi-arid regions that have igneous rocks with high concentrations of copper, such as in western Brazil, southern Venezuela, Mexico, and Chile (Cody 1991). There is the possibility that some turquoise that has been reported was, in fact, misidentified, though the specimens from Trants have been geologically confirmed. Other stones that are often misidentified as turquoise include azurlite, malachite, and chrysocolla. The only way to verify the origins of these specimens is to test them chemically.

For the most part, studies of these finished beads and amulets, and the byproducts of their production, have relied on gemological identification of both finished products and transported raw materials. Possible geological sources for these goods have been hypothesized over the years, including the Guayana Shield of southern Venezuela/Brazil border, southern Brazil, and the western Brazilean Shield (Cody 1990, 1991). In most of these previous studies, however, the islands themselves were never considered as possible sources. Additionally, the possibility that the sources of many of these ornaments and ceremonial tools (celts and axes) lay outside the familiar and comfortable confines of Lowland Amazonia, as defined by Rouse and Cruxent, has not been seriously considered until recently.

Serpentine, periodite, and possibly nephrite would have been available on Puerto Rico and Hispaniola, and possibly the Virgin Islands, especially St. Croix. Barite, chalcedony (including carnelian and jaspers), chert, and quartz have been geologically identified on Antigua, in addition to limestone and diorite (Murphy et al. 2000). However, amethyst, nephrite, serpentine, and turquoise have not been observed on this island. High quality chert is known to occur on Antigua and the surrounding small islands and cays, especially on Flinty Bay, Long Island (Crock and Bartone 1998). Finally, jadeitite is the particular kind of jadeite identified is typically associated with a serpentinite mélange with blue schist and eclogite (Harlow et al. 2006:319). There is the potential for jadeitite-producing mélanges in Cuba, the eastern portion of Hispaniola, and Jamaica, though to date none have been identified.

To date, there have been few compositional studies of lithic materials recovered from these archaeological sites; there has been only one systematic attempt to identify likely sources through geochemistry of geological samples of rock outcrops and exposures. Knippenberg's study (2006) of Long Island, Antigua flint and St. Martin greenstone and calci-rudite is one of the first geochemical studies of stone artifacts and their potential sources in the region. Knippenberg found that during the Early Ceramic Age (Saladoid period), Long Island flint, a characteristic honey brown or a dark gray with calcite inclusions, was likely transported as cobbles by people with direct access to sources to nearby islands within a region that grew to include Saba and Guadeloupe. The presence of Long Island flint on Puerto Rico, Vieques, the Virgin Islands, and Martinique is explained as down-the-line movement (Knippenberg 2006:265). During the Late Ceramic Age (Ostionoid period), Long Island flint is not observed beyond the Anegada Passage. The movement of Long Island flint throughout the region dates back to the Ortoiroid or Archaic period, and it's continued presence on islands that had both Archaic and Saladoid period occupations possibly attests to interactions and communications between these two cultural groups.

St. Martin greenstone is a gray-green mudstone that is identified by its peculiar trait of developing a chalky calcite exterior. While exposures are known to exist on the island, there are no known archaeological sites associated with these outcrops. (Knippenberg 2006:244). Production of greenstone celts was confined to only a few sites proposed to be near sources, though no sources are known (Knippenberg 2006:245); during the first part of the Early Ceramic Age, evidence of production has only been encountered at the Hope Estate site (St. Martin). By the end of the Early Ceramic Age, St. Martin greenstone axes were being made on Anguilla (the Rendezvous Bay and Sandy Ground sites) and St. Eustatius (the Golden Rock site). Finished St. Martin greenstone axes have been reported from Early Ceramic Age archaeological sites on Puerto Rico (the Punta Candelero site) and Vieques (La Hueca/Sorcé), Nevis, Antigua, and Guadeloupe, though by the end of the Early Saladoid period there are no reports of occurrences in either Puerto Rico or Vieques. During the Late Ceramic Age, Anguilla became a "central place for greenstone celt production" (Knippenberg 2006:249), and the axes appear again on Puerto Rico (at the Paso del Indio site). To summarize, the production of greenstone axes was confined to a region bounded by Anguilla to the north and Guadeloupe to the south.

Calci-rudite is a conglomerate, bounded with a fine grained carbonate. It was used in the production of three-pointers, in addition to coral, limestone, shell, and other kinds of stone (Knippenberg 2006:254). Three-pointers have not been observed in most Early Ceramic (Early Saladoid) Age contexts, and it has been hypothesized that they did not appear as part of the Saladoid "suite" until circa A.D. 400 (Knippenberg 2006:255). It was proposed that production of three-pointers was confined to Anguilla during the end of the Early Ceramic Age, and then spread to St. Martin at the beginning of the Late Ceramic Age; there is no known occurrence of calci-rudite three pointers after the end of the Late Ceramic Age. Finished three-pointers appear on Montserrat (Trants), Antigua (Elliot's), and St. Eustatius (Golden Rock) during the Early period, and on Puerto Rico (Paso del Indio), Antigua (Mill Reef), and Guadeloupe (Anse á l'Eau and Anse á la Gourde) during the first part of the Late period. Finally, there is only one known source for calci-rudite: Point Arago on St. Martin.

To summarize, when Saladoid period peoples arrived at the northern Lesser Antilles and the Greater Antilles they began to exploit flint sources on Antigua, possibly as a result of interactions with "Archaic" groups already living in the region. Soon, production of "greenstone" axes began on St. Martin and Anguilla, and the finished products were transported as far as Puerto Rico and Guadeloupe. As greenstone axe production increased the transportation of Antigua flints decreased; at the same time, limited production of calci-rudite three pointers began on St. Martin and Anguilla, with a limited distribution of finished goods. Knippenberg has interpreted the access to Long Island flints, and the production of tools, as open, with many communities having access to the extensive flint beaches on the cay. On the other hand, St. Martin and Anguilla "greenstone" and calci-rudite sources and production was restricted and controlled, both materials viewed as having symbolic value.

Recent studies have also provided evidence for long distance trade and/or contact with regions outside those traditionally (and comfortably) associated with the Saladoid culture region. Murphy and Harlow's study (2006) of jadeite axes recovered archaeologically from Antigua found that they were likely quarried from the southern side of the Motagua fault in Guatemala, based on SEM, XRD, and electron microprobe (Harlow et al. 2006). However, the study could not rule out the possibility that an unknown jadeite source could have been located somewhere in Hispaniola, Cuba, or Jamaica. This study has thrown a proverbial wrench into the debate over the extensiveness of Saladoid exchange and interaction networks by presenting the possibility that presumptions of South American origins for the semi-precious stones used in the production of beads and ornaments could be false.

Though not the focus of this study, there were other objects transported from the South American mainland. These objects included *guanin,* an alloy of gold and copper that was hammered into a variety of shapes, likely originating from the Isthmo-Colombian region, and freshwater bivalves (naiads) of species found only in the Amazonian and Orinocan basins (*Nerida* sp.) (Boomert 2000a:428; Vescelius and Robinson 1979). The Andersen Collection on St. Croix includes 173 pieces of worked naiad (freshwater mussel) shell made, genus *Prisodon*. All of these freshwater bivalves were recovered by Andersen from the Richmond (12VAm1–4) and St. Georges (12VAm1–30) sites. Some of these objects were carved in a variety of geometric images similar to the iconography present on Saladoid WOR wares, while others are carved and perforated in a number of shapes and forms (Vescelius and Robinson 1979:6). Future studies on the exchange networks of the prehistoric Caribbean should focus on these long-ignored kinds of objects.

Pottery Styles and Interaction

The study of stylistic and design elements is not solely the study of cultural continuity and change over time, but can provide insight into definitions of group membership and social identity (Hegmon 1992; Hill 1985; Parkinson 2006; Rice 2006:267 Wobst 1977). Style is "both a component of human activity" and can be indicative of variation in material culture, identified systematically through the tracking of attributes (Hegmon 1992:519); in this way, style is both an active and passive phenomenon. Similarities in decorative and stylistic elements are not necessarily only indicative of common physical origins or of movements or migrations across a landscape, but also of shared symbolic value and heritage through a variety of means of communication of ideas and knowledge. These identities, in turn, are not necessarily defined by kinship, but can cross-cut blood ties via economic and “fictive” relations (Rice 2006:255). In other words, stylistic variability is representative of social interaction, and demonstrates the creation, development, and maintenance of social boundaries (Parkinson 2006). Assumptions surrounding older, symbolic functionalist and interaction approaches do not account for the contexts that influence stylistic variability and diversity in pottery production, decoration, and use, in addition to assumed correlations between stylistic similarity and intensity of social interaction (Rice 2006:254; Wobst 1977). Today, the influence of social networks on the production of goods and symbolic significance are imbued in their shape, use, and symbolic design motifs. The meanings of these symbolic elements can be multivocal and multivalent: they may have different meanings to different social groups, they can be interpreted, reinterpreted, and purposefully modified, and they may change over time. Additionally, the processes of pottery production itself, such as clay and temper selection, the relations necessary to obtain materials, and the maintenance of styles over time through the interaction involved in teaching and learning are just as informative about the active roles people play as the communicative roles of the selected style (Hegmon 1992; Hill 1985; Stark et al. 2000).

Assumptions regarding the origins of Saladoid peoples, based on pottery stylistic and design elements or attributes, have largely followed the findings of Rouse and Cruxent’s archaeological surveys in Venezuela (Rouse and Cruxent 1963). In short, the original chronology for the Middle and Lower Orinoco claims that the Saladoid series developed out of the La Gruta style (ca. 4450 – 2950 BP, or 2500 B.C. – 1000 B.C.); the Barrancoid ceramic series also grew out of the La Gruta style (Gassón 2002:278). According to Rouse and Cruxent, the Saladero style, ca. 3000 – 1600 BP (1050 B.C. – A.D. 350) was related to the Ronquín style of the Middle Orinoco (ca. 1050 B.C.) Cross-hatched and incised ceramic wares are also associated with the Ronquín style.

Other chronologies have been developed, namely by Sanoja and Vargas, that reduced the timeline and reorganized the periods and series into two phases (Ronquín and Corozal) and periods (Ronquín Period I: ca. 2550 – 1950 BP or 550 B.C. – 0 A.D., Period II: ca. 1950 – 1650 BP or 0 – 300 A.D.; Corozal ca. 1350 BP). The Barrancoid ceramic series, in this chronology, is believed to have had ancestral origins in the Northern Andean Formative (Gassón 2002:278). For the Lower Orinoco region, the Saladoid ceramic series is viewed to be a component of the Barrancas tradition, divided into three periods (Preclassic, Classic, and Postclassic) (Gassón 2002:289). Still other chronologies split the difference between these two extremes (Zucchi 1972, 1973; Zucchi et al. 1984). The introduction of new ceramic wares, namely cauixí tempered (sponge spicule) wares by ca. 1350 BP (ca. 600 A.D.), has been presented by Zucchi as evidence for exchange and possibly cohabitation of communities (the Agüerito site) by different ethnic groups (Zucchi et al. 1984:179).

In the Middle Orinoco region, cauixí tempering has been traditionally associated as an Arauquinoid attribute, that had developed out of the Saladoid series wares which, in turn, was influenced by Barrancoid, Amazonian, and western traits (Boomert 2003; Gassón 2002:279-280). Additional Arauquinoid attributes include "rectilinear, fine-lined incised designs, often filled with red paint, and crude anthropomorphic faces on vessel walls" (Boomert 2003:165). These wares have been dated in archaeological contexts to ca. 1550 – 1450 BP (ca. 400 – 500 A.D.), with expansions into the western Llanos region from ca. 950 – 550 BP (ca. 1000 – 1400 A.D.) The Arauquinoid ceramic series has long been associated with speakers of Cariban languages, but there is no evidence they are correlated (Boomert 2003:165).

A conclusion that can be drawn from the above discussion is that there were numerous societies and communities throughout the northeastern South America and Lowland Amazonia, and that their travels, exchanges, and interactions were not sporadic (Boomert 2003; Gassón 2002). These exchanges and interactions, especially for rare goods that would be regarded with high status, would not have been "ecologically driven, but rather stemmed from economic and political pursuits" (Gassón 2002:263). While the chronologies and specific movements and migrations are not completely agreed upon, the general view is that the that the Barrancoid series did not develop out of the Saladoid, instead originating from the Isla Barrancas style in the Venezuelan central llanos (savannas) and northeastern Colombia (Boomert 2003:145; Gassón 2002:267). Isla Barrancas style, dating from ca. 2600 – 1765 BP (ca. 650 B.C. – A.D.185), consists of flanged, hemispheric bowls, with red paint, simple incision, modeled and incised buttons or nubbins, and zoomorphic *adornos*. By ca. A.D. 350, Barrancoid stylistic attributes, including incised curvilinear lines, incised lines ending in dots, and zones painted in red and/or black film were beginning to influence Saladoid ceramics, which then spread to Trinidad, the Windward Islands, and the Guianas (Boomert 2003:160).

In sum, while there are many unanswered questions regarding the origins of Saladoid period peoples and their exchange spheres, some overall observations can be proposed. First, many Early Ceramic (Cedrosan/Hacienda Grande/Prosperity) archaeological sites have produced evidence for participation in regional interaction spheres that incorporated beads and ornaments made of stone and shell, with some communities (or Houses) participating as specialized production centers. Production was most likely conducted as part-time household and/or community form of specialization, and was not based on proximity to raw materials, therefore indicating that raw material was transported from a point of origin to a locus of production, then on to a final destination.

Second, many of these sites (communities, villages) also contained both WOR wares and some ZIC, with no spatial differentiation in their distribution. Other sites, such as La Hueca/Sorcé, Punta Candelero, and Hope Estate (St. Martin) do have an apparent spatial segregation of Huecan components. In most cases, studies have not been conducted to determine if these ceramics were being made locally, and if clay sources were located in close proximity to communities (proximity is defined as one kilometer, with a basic resource area that includes a five to seven kilometer radius around a given community (Arnold 1985:57-58; Rice 2006:116)). It is not known if ceramic production was also specialized at the household or community level.

Third, if Lowland Amazonian models of Arawakan interaction hold true, then the Huecan components at these early archaeological sites could be indicative of multicultural and/or pluricultural societies, some of which could have been single villages with multiple cultural or ethnic groups living side by side. Like many Lowland Amazonian and Orinoquian groups, particular communities could have specialized in the production of certain desired or prestige goods and participated in regional interaction spheres that would occasionally meet at "trade fairs," festivities, and ceremonies, or participated in trading voyages.

Museum Collections Study

The museum collections studies were conducted between 2002 and 2006 at the following institutions: the Smithsonian's Institution's Museum of Natural History and the National Museum of the American Indian (Washington, D.C.), the Peabody Museum at Yale University (New Haven, CT), the Danish National Museum (Copenhagen, Denmark), and Christiansted National Historic Site (Christiansted, St. Croix). This study concentrated primarily on ceramic series, styles, and decorative elements, and the presence or absence of polished stone axes and celts, and semi-precious beads and amulets. Because of the sizes of these collections, some of which numbered over 12,000 specimens, the lack of standardized excavation and recovery methods, and subsequently their fragmentary nature not all of the artifacts were subjected to detailed analysis. While all cataloged artifacts were checked and verified against their database entries, particular ceramic sherds were selected based on series, style, form, function, and decoration. The presence of particular decorative elements, production, and style were noted but could not be fully quantified.

These collections were studied for several reasons. First, because of the rate of housing and resort development in the Caribbean, especially the Virgin Islands, many sites have been destroyed. In some cases, these collections represent the only archaeological work that was conducted at a site, and unfortunately much of this work was unscientific and not controlled. The majority of the collections that were studied were those of the Salt River site, for several reasons. First, as described earlier, the site is now within the boundary of the National Park Service's Salt River Bay National Historic Site and Ecological Preserve. These studies were conducted for the National Park Service to check inventories and the original analysis against more recent research and findings in the region. Other sites that were also examined that had good provenience and represented long periods of occupation included Richmond (12VAm1–4), Windsor (12VAm1–44, 47), Glynn (12VAm1–13, 14), Sprat Hall (12VAm1–12, 26), Prosperity (12VAm1–11), St. George (12VAm1–30), Butler Bay (12VAm1–51), Great Pond (12VAm1–28), and River (12VAm1–22).

Ceramic Styles

The results of this study produced some finds that were not presented in the original reports written following the original excavations or massing of collections. First, there were several types of wares that are not typically discussed in the literature, at least for Crucian sites. One finding was a group of ceramics observed as having a burnished buff slip with brushing on the interior flanges of vessel necks; in some cases they were heavily burnished, and the brushing was in a criss-cross pattern (Figure 49). In the Vescelius Collection, these wares were typically observed in Levels C through G at Salt River, Sprat Hall, River, and the surface at Prosperity. Some of these buff burnished wares from Salt River (Pit 7, Level E, 30-36 inches below surface), and River (Pit 3, Levels C, D, 18-30 inches below surface) sites. These sherds averaged five to seven mm in thickness, and were tempered with fine sands. Brushing could be representative of a distinctive ware type used for particular functions, an outward symbol of membership in a particular house, or the manufacturing style of an individual potter. Of course, this is all speculative without additional close examination of all of these collections, namely those that have never been fully analyzed or even inventoried.

A second type of ware that was noted was a pale yellow to white chalky ware (Figure 50). Thin section slides made of several sherds of this type of ware that were recovered from the Judith's Fancy site indicate that they are comprised primarily of calcite and calcium carbonate. Foraminifera shells, etc. have not been observed in these sherds, and it was suspected that caliche could have been used in their manufacture. These wares were identified from three sites in the Vescelius Collection: Salt River (Pit 7, Levels C, D, E; Pit 12, Levels D and I), Sprat Hall ("surface"), and River (Pit 4, Level E). They were also recovered during National Park Service 2005 excavations at the Judith's Fancy site (Hardy 2007). In general, they were recovered in same proveniences as the brushed tan/buff slip and burnished wares. They were thinner (3.6-3.8, and 4-6 mm), and generally confined to incurving vessels, some of which were carinated. These wares were also noted in the Hatt Collection in the A-block excavations (or, in proximity to the ballcourt and plaza) (Figure 51). Light buff colored to white paste, thin walled wares with burnishing are typically attributed to the Earliest Saladoid populations. However, the stratigraphic locations of these chalky wares chronoogically places them with the Coral Bay — Longford and possibly Magens — Bay Salt River I phases.

Figure 49. Brushed flange wares. River site, cat. # 190331. Vescelius Collection, courtesy of the Yale Peabody Museum, New Haven.

Figure 50. “Chalky wares.” Salt River site, cat. # 190103. Vescelius Collection, courtesy of the Yale Peabody Museum, New Haven.

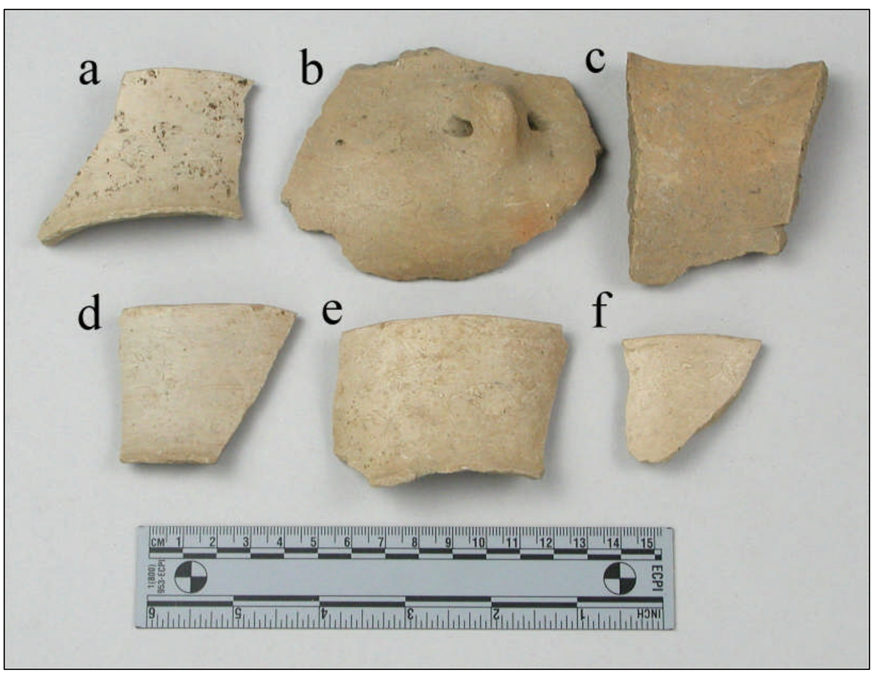


Figure 51. “Chalky wares” and smoothed-burnished wares, Early Saladoid period. Salt River site, cat. #s: a, d, e, and f: 11.1137; b: 11.1134, c: 11.1131. Gudmond Hatt Collection, courtesy of the Danish National Museum.

Prosperity phase ceramics reminiscent of Huecan styles were observed in the Andersen Collection, most originating from the Prosperity and St. Georges sites. These styles included red filmed vessels with thin curving incised lines and punctated knobs (Figure 52; see also Figure 16). ZIC wares were observed from the St. Georges and, possibly Richmond sites (Figure 53). WOR wares have all been recovered from these same sites, but at this time it is not known if these wares were located in distinct, segregated or mixed contexts.

Polychrome wares painted with orange and red, some with incisions outlining red painted areas, were associated with the Glynn, St. Georges, Prosperity, and Windsor sites (Figures 54 and 55). Brown and white filmed vessels, and burnished buff with brown painting, incising, and punctuated knobs were recovered from the Prosperity site (Figure 56). Orange slipped wares appear to have been confined to the Salt River drainage, especially the Glynn and Windsor sites, though friable, interior orange slipped wares with red filmed exteriors was reported by Vescelius for the Prosperity site. Simple orange-slipped wares were also recovered during archaeological investigations at the Judith's Fancy site (Hardy 2006).

Figure 52. Incised and knobbed-with-punctation and red film. Prosperity site, cat. # A-470 (2116). Folmer Andersen Collection, courtesy of Christiansted National Historic Site.

Figure 53. ZIC ware, Early Saladoid period (Prosperity phase). St. Georges site, cat. # A-387 (2802). Folmer Andersen Collection, courtesy of Christiansted National Historic Site.

Figure 54. Polychrome wares, Saladoid period. Cat. #s: a, A-927 (2426); b, A-1125 (2748); c, A-1122 (2115); d, A-931 (2436); e, A-930 (2435); f, A-1120 (2110). A, d, and e: Aklis, Richmond, or St. Georges site; b: St. Georges site; c and f: Prosperity site. Folmer Andersen Collection, courtesy of Christiansted National Historic Site.

Figure 55. Red and buff platter with duck-head adorno. St. Georges site, cat. # 2607. Folmer Andersen Collection, courtesy of Christiansted National Historic Site.

Figure 56. Brown and white filmed vessel fragment. Prosperity site, cat. # A-1124 (2114). Folmer Andersen Collection, courtesy of Christiansted National Historic Site.

The Hatt Collection of artifacts from the Salt River site was comprised overwhelmingly of Coral Bay — Longford and Magens — Bay Salt River I through III-style ceramics. This was surprising, as the Salt River site has always been described as one of the oldest on the island (Prosperity period).

The earliest wares that were observed included a variety of decorative elements, such as geometric designs like I and H-forms and circles, painted in red film on either a white or buff background, painted black-on-buff designs on the interiors of open bowls and platters, and painted parallel lines (Figures 57 through 60). The painted black designs ranged from curvilinear and cleanly executed elements to more simple geometric designs.

Later wares were deeply incised, with circular elements continuing to be produced (Figures 61 and 62). Other incised decorative elements included parallel lines, lateral parallel lines, and angular or chevron-like parallel lines, either on vessel rims or on exterior bodies near rims, which were similar to Ostiones and Esperanza subseries from Puerto Rico (Figures 63 through 66). There were also examples of deep and fat incisions ending in dots.

Figure 57. Possible transition from Prosperity to Coral Bay — Longford. Black on Buff wares. Salt River site, cat. # 13.30. Gudmond Hatt Collection, courtesy of the Danish National Museum, Copenhagen.

Figure 58. Polychrome and red-on-black sherds, Coral Bay — Longford phase. Salt River site, cat #s: a, d, e, f, g, 73371; b, 73373; c, 73309. De Booy Collection, courtesy of the National Museum of the American Indian, Washington, D.C.

Figure 59. Reconstructed open bowl or platter, with red film geometric design on interior, Coral Bay — Longford to Magens Bay — Salt River I phases. Salt River site, cat. # 73377. De Booy Collection, courtesy of the National Museum of the American Indian, Washington, D.C.

Figure 60. Partial red film platter with buff (negative) design; dark brown is reconstruction. Salt River site, cat. # 11.1061. Gudmond Hatt Collection, courtesy of the Danish National Museum, Copenhagen.

Figure 61. Incised and carinated bowl, Magens Bay — Salt River II or III phase. Similar to wares recovered from Belmont site, Tortola, British Virgin Islands. Salt River site, cat. # 11.77. Gudmond Hatt Collection, courtesy of the Danish National Museum, Copenhagen.

Figure 62. Salt River — Magens Bay II or III. Similar to Capa, Puerto Rico. Salt River site, cat. # 11.648. Gudmond Hatt Collection, courtesy of the Danish National Museum, Copenhagen.

Figure 63. Parallel incised lines on rim. Salt River site, cat. # 12.301. Gudmond Hatt Collection, courtesy of the Danish National Museum, Copenhagen.

Figure 64. Curvilinear incised lines. Salt River site, cat. # 11.193. Gudmond Hatt Collection, courtesy of the Danish National Museum, Copenhagen.

Figure 65. Angular or chevron-like incised lines at rim. Salt River site, cat. #11.344. Gudmond Hatt Collection, courtesy of the Danish National Museum, Copenhagen.

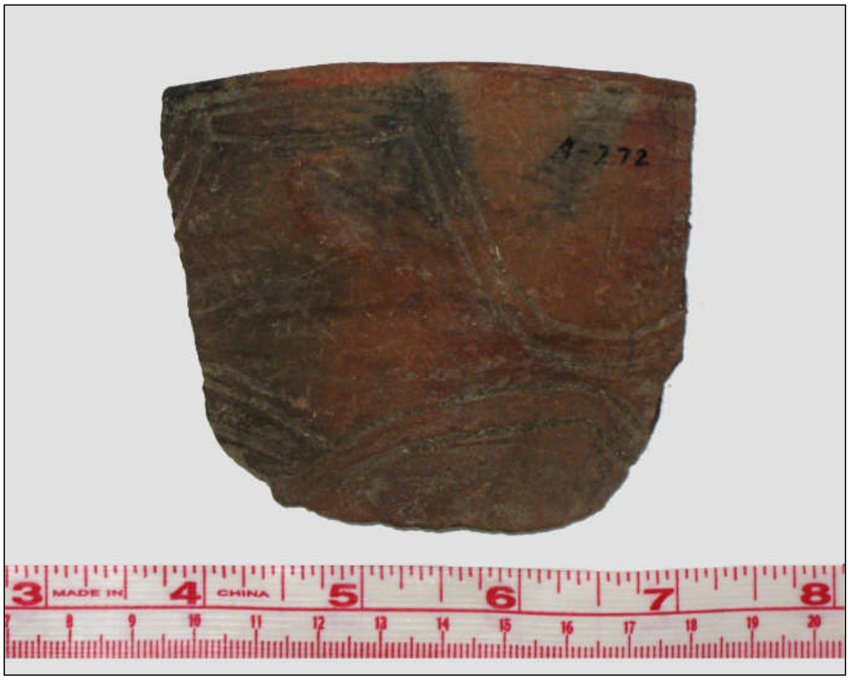


Figure 66. Parallel incised lines in geometric pattern. Glynn site, cat. # A-272 (2405). Folmer Andersen Collection, courtesy of Christiansted National Historic Site.

Overall, the only sites that have demonstrated evidence of Prosperity phase decorations on ceramics have been the Aklis, Prosperity, Glynn, Richmond, St. Georges, and possibly Salt River sites. All of these sites are located on the coast and near the mouths of watersheds. The presence of finely made WOR wares contradicts the radiometric dates that have been obtained for the site, and begs for additional excavations to be conducted. However, it cannot be ruled out that Early Saladoid components for Aklis may have been eroded.

Stylistic changes in ceramics on St. Croix and throughout the Virgin Islands indicate some degree of interaction with communities in eastern Puerto Rico and eastern Hispaniola (Dominican Republic). As discussed in Chapter 3, studies by Morse (1989, 1995, 2005) and Lundberg and Righter (1999) have found that many of the style attributes demonstrate continued close contact with the developing Ostionoid hierarchical societies. As the regional and macro-regionally oriented societies began to diversity and create small-worlds on local and regional scales, the once more rigid stylistic boundaries defining Saladoid versus non-Saladoid identity became increasingly permeable. Localized and regional stylistic variability increased, continuing along this path well into the Ostionoid period. However, the presence of particular stylistic elements across regions, such as Ostiones, Esperanza, Capá, Chican, and Boca Chica, are illustrative of interactions between individual communities. These relations, as will be demonstrated later in this chapter, likely originated during Saladoid times.

Griddle rims were also examined, and compared to a style guide for ceramic forms and decorative styles, including rim shapes, established by Kenneth Wild (Virgin Islands National Park) and Emily Lundberg (Figure 67). In general, griddle rims from the Ostionoid period tend to all have some form of upward or raised rim, while those from the Saladoid period reflect a mix of flat and raised edges. In the Vescelius Collection at Yale, the majority of griddles observed from lower levels at all sites (levels E through H, 24-60 inches below surface; roughly equated with Prosperity and Coral Bay — Longford phases), had E, G, H, I, J, and L-style rims. Those from upper levels (levels A through D, 0-24 inches below surface; roughly equated with Magens Bay — Salt River I and II phases), had A, B, and E-style rims.

Griddle rims that were available for study in the Hatt Collection were primarily A and D styles, representing excavation blocks A and B. The Andersen Collection included rim styles A and E. Finally, griddle rims recovered during the excavations at the Judith's Fancy site included B (n=6), E and J (n=3 each), C, D, F, G, H, and K (n=1 each).

Stone Styles

Stone ornaments carved into a variety of frog, manatee, and unidentified forms have been observed both in the Andersen and Hatt Collections (Figure 68); these ornaments were recovered primarily from the Salt River site (Hatt Collection), and unfortunately the provenience for the Andersen materials is not detailed enough to discern from what site they originated (St. Georges, Prosperity, or Richmond). Overall, there have been several styles that are found across nearly all the sites discussed above that correspond to studies conducted of similar ornaments and raw materials by Cody (1990, 1991), Kelker (1985), McGinnis (1997), and Turney (2002).

Other styles included segmented frog with a central "belt" (similar to the raised arm-belted female of the Atlantic Watershed of Costa Rica), segmented frogs, "batrachian" elongated *muiraquita* style as defined by Cody (1990) and Turney (2002), and other animal forms, namely a "caterpillar" style and a few examples resembling the carapace and emerging flipper of a turtle (Figure 69). The elongated "batrachian" style resembles the flat-headed frog motifs with deeply cut channels representing folded-leg style from Colombia, considered a South American trait (Kelker 1985:62). The earliest frog motifs are found on pottery in the Isthmo-Colombian region

(Puerto Hormiga site) and date to ca. 3090 ±70 B.C. to 2550 B.C. These motifs diffused from the Colombian north coast throughout Colombia and Panama (Kelker 1985:44). Manatee-style ornaments were observed in the Lewis Korn and William King Collection, also housed at the National Museum of the American Indian (Figure 70). There are no known vulture or bird ornaments reported for St. Croix. Though not discussed in detail in this study, the banded-birthing-female/frog style of pendant was also observed, though these objects were not made of greenstones but of materials resembling diorite.

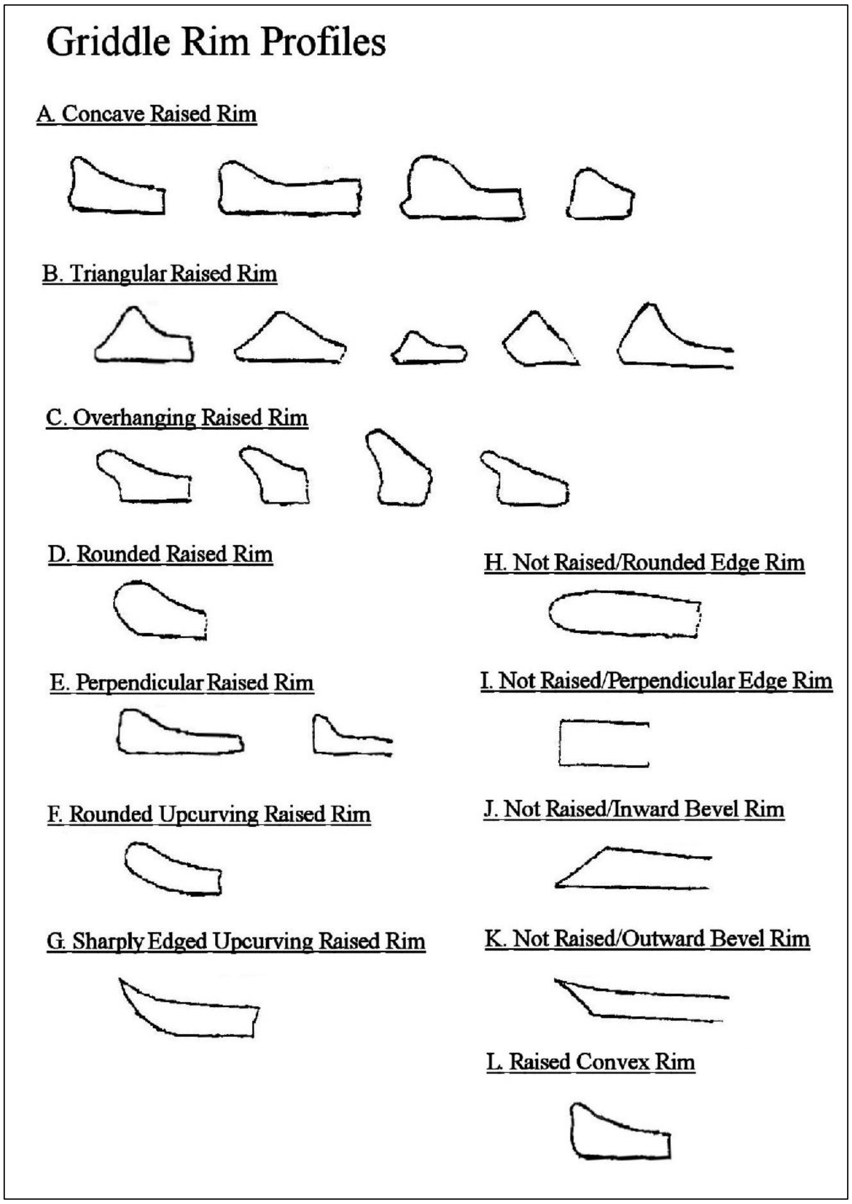


Figure 67. Illustration of griddle rim types. Adapted from style guide created by Lundberg and Wild. Courtesy of Kenneth Wild, Virgin Islands National Park, and Emily Lundberg.

The frog and "batrachian"-style ornaments in these collections demonstrate two forms of suspension, the *muiraquita*-style with suspension holes drilled into the sides and back so as not to be observed from the front, and holes drilled from front to back. Single-hole simple, rounded pendants were observed, made out of materials resembling turquoise, malachite, and amazonite.

Finally, raw, unworked pieces of stone, namely in the Folmer Andersen Collection, included possibly malachite and/or turquoise, carnelian, amethyst, and quartz, in addition to cobbles of cherts and jaspers in a variety of colors. The Andersen Collection included pieces of flint that resembled Long Island flint described earlier, though closer examination is needed in order to support this contention (see Figure 48).

Figure 68. Variety of carved stone ornaments recovered from archaeological sites across St. Croix. A, b: "Batrachian" style ornament with *muiraquita*-style suspension holes; c: possible *muiraquita*-style, broken; d: variant of "batrachian" style, cat. # 2016; e: segmented frog with flat top; f: segmented form, possible frog with flat top, cat. # 2018, Panamanian or Costa-Rican style; g: non-segmented frog with side channeled legs; h: broken and miscellaneous, possible frog or "batrachian" style, cat. # 2024; i: segmented frog, *muiraquita*-style suspension holes, cat. # 2021; j: "caterpillar" style, cat. # . A, b, c, e, and g are all from the Salt River site, Gudmond Hatt Collection, Danish National Museum; d, f, h, i, and j are from the Folmer Andersen Collection, Christiansted National Historic Site, sites unknown. Not to scale. All images taken by author.

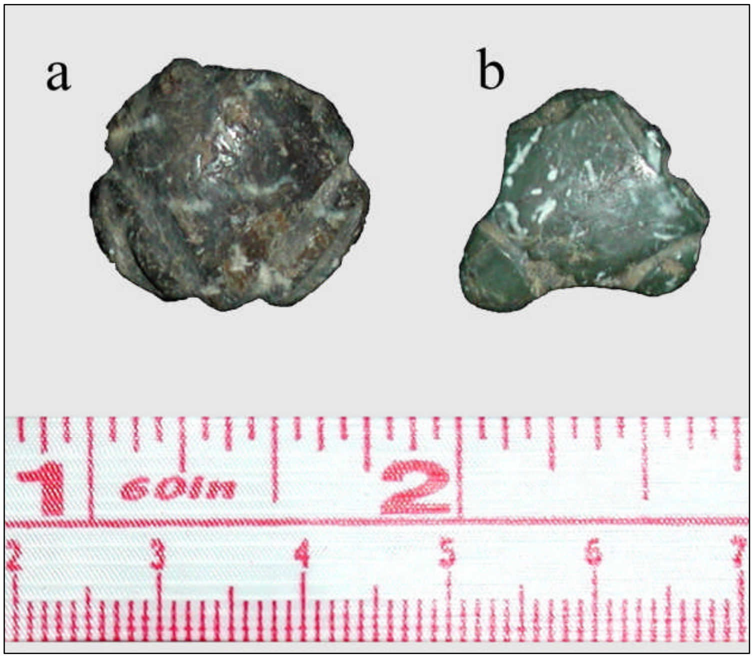


Figure 69. Two broken "batrachian" and/or possible turtle ornaments. Sites unknown, cat. #s: a, 2025; b, 2026. Folmer Andersen Collection, courtesy of Christiansted National Historic Site.

Figure 70. Manatee ornament. "Frederiksted, South of Concordia," cat. # 187109. Lewis J. Korn and Willard V. King Collection, courtesy of the National Museum of the American Indian, Washington, D.C.

Highly polished axes and celts, with no evidence of wear resulting from being used as tools, have been recovered from sites across St. Croix, including Aklis, Judith's Fancy, Prosperity, Richmond, St. Georges, and Salt River (Figures 71 and 72). Many of these polished axes and celts were made of a variety of "greenstone" materials that resemble light green jadeites as described by Harlow (Harlow et al. 2006). Initial observations of these axes indicated that they were made of a variety of greenstones, most likely forms of jadeite, again indicative of interisland and island-mainland interaction and symbolic value. Some of these polished celts that happened to break apparently lost their symbolic value, and were then available for use as tools. On the other hand, unpolished axes and celts, at least those observed in several collections of Crucian materials, were made of andesite and other metavolcanics and used in a variety of tool forms.

Figure 71. Polished and broken "greenstone" celts. Left: Aklis site; right: Judith's Fancy site (SARI cat. # 01052). Aklis celt found eroding from exposed bank. Judith's Fancy celt was reused after being broken.

Figure 72. Broken polished "greenstone" celts. Cat. #s: a, 664-3; b, 664-4. Folmer Andersen Collection, courtesy of Christiansted National Historic Site.

Figure 73. Earspool. "South of Concordia," cat. # 187233. National Museum of the American Indian, Washington, D.C.

Finally, three ground earspools was observed in the collections of the National Museum of the American Indian, as part of the Lewis Korn Collection of materials from St. Croix (Figure 73). The materials of these object is not known, though quartzite is a major constituent. These are the only known earspools observed in all these collections for St. Croix.

Other Objects

A final note must be made regarding other objects observed in the collections. Namely, the numerous amounts of carved shell and bone ornaments, tools, and other objects, including a bone flute or trumpet observed in the Andersen Collection. There are also flat shell "three pointers" that resemble the shell and stone three pointers only in shape. They closely resemble ornaments observed in the Isthmo-Colombian region where they were used in conjunction with quartzite cylinders as symbols of prestige and rank (see Figure 14, Chapter 3; see also Figure 1, Quilter 2003:11). These kinds of artifact materials have long been ignored by researchers, and a standardized typology for styles, form, and possible function does not exist for the region.

Chemical Ceramic Studies

Background

Research into the development of social complexity and exchange networks among island societies has been conducted in Oceania (Earle 2002 [1977]; Green 1986; Gumerman 1986; Irwin 1978; Kirch 1991, 1988; Summerhayes 2004; Weisler 1998), the Cyclades (Broodbank (1989, 1993, 2000), and the Channel Islands (Arnold 1992, 1995, 2001). In particular, several studies of ceramic origins and movement of tempering agents have been conducted for island societies in Melanesia and Near Oceania (Kennet et al. 2004). Over the last three decades, many other studies throughout the Americas have used neutron activation analysis to trace the movement of ceramics and tempering agents across the cultural landscape (Arnold et al. 1991; Herrera et al. 1999; Neff and Bove 1999).

Chemical studies of pottery from across the Caribbean have yielded evidence that the movement of goods between islands is nearly constant, through both prehistoric and colonial times. Previous studies of prehistoric ceramic composition for Virgin Islands assemblages have largely concentrated on collections from St. Thomas and St. John. In his master's thesis, Doug

Potter (1996) analyzed 17 clay samples and 23 ceramic sherds from five archaeological sites on St. John, U.S. Virgin Islands using both proton induced x-ray emission (PIXE) and x-ray diffraction (XRD). Potter had three primary objectives: to determine possible sources of prehistoric pottery on St. John, to examine variation within both the clay and the pottery, and to examine intra- versus intersite variability. The results of the XRD study found that the majority of ceramic sherds were recovered in close proximity to local clays which were the products of the surrounding parent rock. The PIXE data partially supported these results by indicating which of certain selected indexed elements (K, Si, Fe, Ca) were present at each site. However, there was no discussion of variation between refined and utilitarian forms of wares.

Carini (1991) studied 93 samples of Saladoid period ceramics from 10 archaeological sites on 5 islands (including Salt River, St. Croix), and from one site on Venezuela, the Saladero site (the type site for Saladoid ceramics). No potential clay sources were examined. Carini utilized five methods: emission spectrography, infrared absorption spectrophotometry, x-ray fluorescence, petrographic microscopy, and electron scanning microscopy; however, only infrared absorption was used on all 93 sherds. He identified several compositional modes which seemed to indicate that while some ceramics were traded between islands, others were used in close proximity to where they were produced.

Barbara O'Connor (2001) prepared thin sections from 18 ceramic sherds from four prehistoric sites on St. Croix: Prosperity, Northside, Aklis, and Salt River. Over 300 points were counted on each slide. O'Connor concluded that the sherds from the Prosperity and Northside sites corresponded to nearby natural clay deposits, while the Salt River and Aklis sherds did not.

Neutron Activation Analysis — Results

As part of the larger comparative collections study, 86 samples of ceramics and clays were submitted to the Archeometry Laboratory of the University of Missouri Research Reactor Center (MURR): 75 ceramic sherds and 11 clay samples. Thirty-seven of the ceramic sherds were excavated by this researcher during the summer 2005 archaeological investigations at the Judith's Fancy site; the remaining 38 were collected by Folmer Andersen from seven archaeological sites across St. Croix that were either contemporaneous with or older than the Judith's Fancy site (see Appendices A and B). These sites were Aklis, Glynn, Prosperity, Richmond, Salt River, St. Georges, and Windsor. The Andersen Collection is housed at the National Park Service's

Christiansted National Historic site. As discussed in Chapter 1, the sherds were selected because they represented a variety of styles and manufacturing quality.

The eleven samples of local clays were collected from those areas (guts) on island with the best quality clays, some of which have intrusive volcanic components, and were located near known prehistoric sites. These sites were Aklis, Prosperity, and Halfpenny/Manchenil Bay, Little La Grange (in the northwestern mountainous area near the rainforest), Bethlehem and St. Georges (in the central plain area), and Cane Bay, Salt River-Columbus' Landing, and Judith's Fancy (on the northern side of the island) (Figure 74). An additional sample of caliche was taken from the VIALCO Caliche Mine, located on the southwestern side of the island in exposed marine terraces of the previously submerged central valley in the Kingshill Basin (as described in Chapter 3). Caliche is a fine, secondary calcium carbonate that develops when ground water rises through voids and capillaries in areas that are partially humid to partially arid. It can occur as thin crusts and infiltrate vesicles and crevices, as nodules, or as dense layers that can be meters thick. It is commonly found in alluvial plains, where it can "plug up" fans and prevent water from percolating below the surface, leading to flooding. Finally, a sample of red clay was taken from the exposed archaeological site of Mountain Top, St. Thomas. This site had been recently discovered and was still exposed, and is remarkable for its great amount of high quality red clay on the top of the mountain. The site dates to the Ostionoid period; however, the sample was taken as representative of rare, good quality red clay on the islands.

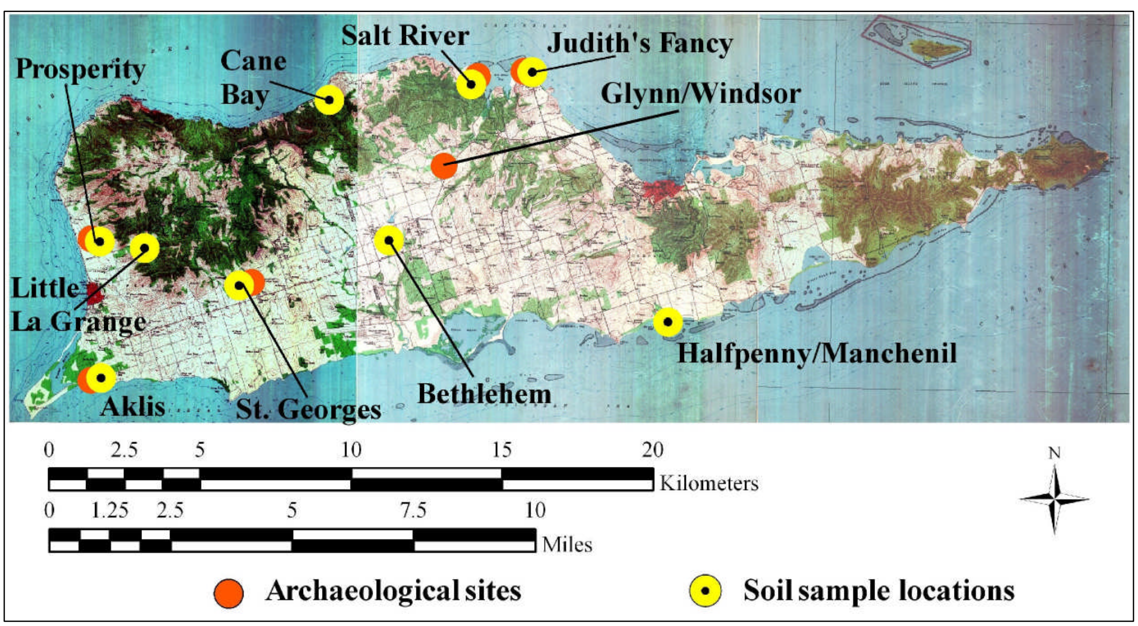


Figure 74. Map showing locations of soil samples and sites with ceramics used in NAA.

Neutron activation analysis (NAA) consists of two irradiations (one short and one long) of ceramic samples, and a total of three gamma counts for 33 elements (Ferguson and Glascock 2006; see Appendix B). The data is then converted to base-10 logarithms of concentrations instead of raw data, which compensates for scalar differences between major and trace elements.

The quantitative analysis of chemical data is generally used to identify homogenous groups within the selected samples. These groups are then assumed to represent geographically restricted areas or "source zones." These data can then be compared to 1) raw materials to identify the actual source, or 2) known geological and sedimentological characteristics of particular geographic areas.

The results of the NAA analysis were then compared by MURR with previous studies of Caribbean ceramics, including 50 sherds from the Vescelius Collection that were submitted to MURR in 2005, by Birgit Faber Morse. This earlier study focused primarily on late Ostionoid period occupation of the Salt River site. Three ceramic compositional groups were identified, the strongest being Groups 1 and 2.

The 2006 study ceramics were analyzed with the 2005 sherds, using principal component analysis to identify groups and subgroups, in conjunction with Mahalanobis distance to describe specimen distance from a group centroid. In the combined study, two groups were identified: Group 1 and Group 2 (see Appendix B); the majority of all the Salt River samples tested in 2005 were found to be members of Group 2. Five of the eleven clay samples also fit in Group 2. The strong statistical changes of group membership indicated that Group 2 ceramics were likely made on St. Croix; which is rare in pottery analysis. The clay samples that were found to be members of Group 2 were from Manchenil/Halfpenny Bay (Granard Gut), Prosperity (the coastal plain located near Jolly Hill Gut), Little La Grange (Jolly Hill Gut), St. Georges (Mint Gut) and Cane Bay (Cane Bay Gut). None of the other clay samples could be assigned to a group. These locations all have Glynn or Glynn-border soils, and all of these locales are therefore potential sources of clays used to produce WOR and ZIC wares. However, the presence of finely produced WOR wares at St. Georges and Prosperity, and ZIC wares at Prosperity, could be evidence that locales of production of refined and decorated wares could have been restricted to these two locales. All of the griddle samples that were tested were members of Group 2, as were both of the ZIC wares and all but one of the red-on-rim or red-in-zone painted wares.

The majority of chalky wares that were tested were also found to be members of Group 2; this included three of the four specimens from the Judith's Fancy site (the remaining sample was unassigned), and two specimens from the Richmond site. The single sample from St. George was a member of Group 1. Finally, one of the two yellowish-white sherds with shell tempering (also from Judith's Fancy) was a member of Group 2, while the other was also unassigned.

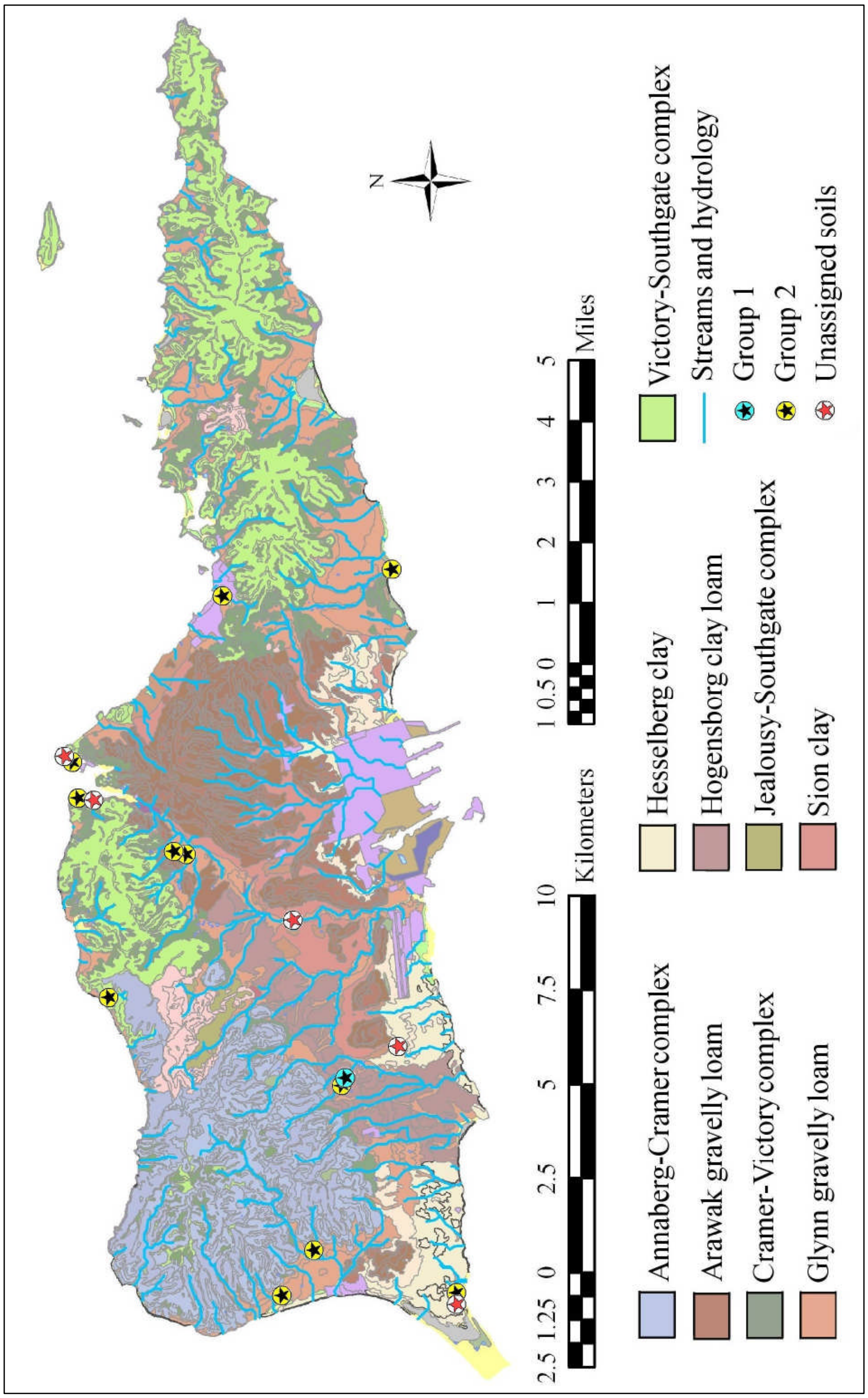


Figure 75. Map showing results from NAA and group membership.

Group 1 was represented by three sherds from Salt River (from the 2005 study) and only two sherds from the 2006 samples; both of these sherds were from the St. Georges site, one being a light colored chalky ware, and one a refined WOR ware.

The remaining sherds and clays could not be assigned to any single group, and there were no links between these samples. These samples included the brown and white painted sherd from the Prosperity site (see Figure 56), one sample of refined WOR ware (Prosperity site), and an orange filmed with red painting outlined by incisions (Windsor site). It is possible that the pottery samples could have originated from an unidentified and unknown off-island source, or they could have been made from St. Croix clays that were not sampled. Additional testing of local clays is needed, in addition to testing of sherds from well provenienced and controlled excavations.

Chemical analysis also revealed that those sherds believed to have been made using caliche did not match those caliche samples that were obtained on island. This does not mean that caliche was not used, only that caliche from that particular sample area was not used. However, it is likely that soils from either the Hesselberg or Arawak series, as described in Chapter 3, may have been used in their production. These soils develop as the result of their marine origins, are comprised of either weathered mountain and hill limestones (Arawak) or marine terraces (Hesselberg), and both contain nodules and concretions of calcium carbonate; however, the clay samples tested from the Aklis site would have been of the Hesselberg series, and they were unassigned to any group. Additional testing on these soils, in tandem with studies of production methods and firing techniques could provide information on the use of calcium carbonates as a material employed in ceramic production on the island.

It is also not known if the production of thin wares with a chalky touch is related in any way to the production of ceramics using cauixí (fresh water sponge spicules) for tempering materials throughout northeastern South America, especially in the Arauquinoid ceramic series of the Middle Orinoco region, as discussed earlier in this chapter (Gassón 2002; Rouse and Cruxent 1963:92). While cauixí tend to make vessels grey in color, their soft, chalky-like touch is similar to these light-colored wares from St. Croix.

The results of this study were then compared to all Caribbean pottery in the MURR database. Interestingly, one sherd from Puerto Rico (Sample PUR 037, Maisabel site) and ten from the Dominican Republic were found to have a strong probability of membership in Group 2, as well (Table 24). This would likely mean that these wares were made from clays on St. Croix. This could have been the result of transporting clays to these neighboring islands (a practice not unheard of when compared to potting strategies around the world), or moving completed pots.

Additionally, the two Group 1 sherds were similar to Puerto Rico's Group 4. Because the Puerto Rico Group 4 example dominates most of that island's pottery samples in the MURR database, it is likely that these Group 1 sherds, both from the St. Georges site were brought to St. Croix from Puerto Rico. Without further testing of potential sources on Puerto Rico, however, its point of origin cannot be speculated.

Additional studies should be conducted on the slips and paints used to decorate these ceramics. ICP-MS (inductively coupled-mass spectrometry) could be used to develop profiles for the clay paints and slips used to decorate WOR and other painted wares. As discussed earlier in this study, potters are known to travel tens of kilometers to obtain specific paints and glazes, further than they typically travel to gather clays. Studies into the possible movement of elements used to decorate refined wares could provide further a depth of understanding into the economic and social interaction systems of these island societies.

Table 24. Non-St. Croix pottery samples with Group 2 membership, MURR database

Sample #	*Site Name*	*Island*	*Percentage Membership*	*Description*
PUR 037	Maisabel	Puerto Rico	56.5	Burial 28; Hacienda Grande style; unslipped, unincised
DOR 108	No description available	Dominican Republic	15.4	No description available
DOR 151	Punta Macao	Dominican Republic	44	Gray paste, linear decoration at rim
DOR 156	Punta Macao	Dominican Republic	7.6	Incised
DOR 158	Punta Macao	Dominican Republic	15	Orange paste, facial design
DOR 159	Punta Macao	Dominican Republic	10	Orange paste, thin
DOR 163	Punta Macao	Dominican Republic	45	Orange paste, sooting
DOR 164	Punta Macao	Dominican Republic	11	Orange paste, sooting
DOR 169	El Corozo del Salado	Dominican Republic	8.8	Orange paste handle, incised lines, eyes
DOR 170	El Corozo del Salado	Dominican Republic	9	Orange paste handle, incised lines, eyes
DOR 174	Los Hoyos de Molina	Dominican Republic	12.5	Buff paste

STONE STUDY – FOLMER ANDERSEN COLLECTION

As previously discussed, extensive Circum-Caribbean maritime trade and communication networks were established in the form of both raw semi-precious stones and finished ornaments and beads. There have been no previous studies of Crucian stone artifacts, save the preliminary analysis of artifacts recovered from the Prosperity site (Vescelius and Robinson 1979).

A total of 39 artifacts from the Folmer Andersen Collection were sent to the American Museum of Natural History (New York City) for identification using scanning electron microscope (SEM), with a back-scattered electron detector (BSE) and a PGT-Imix energy-dispersive X-ray spectrometric analyzer (EDS) (Table 25). Analysis using an electron microprobe determined the concentrations of the primary elements comprising the minerals (Harlow et al. 2006). The artifacts tested included nine stone celts and 16 carved stone ornaments, including six frogs or "batrachian" styles and ten other types (caterpillar and beads). Two "greenstone" flakes and 12 pieces of raw "greenstone" or "turquoise" were also submitted for testing.

While analysis is still ongoing, some initial results are pointing toward the inclusion of St. Croix's Saladoid period communities in these long distance interaction networks. The stone celts were all produced from jadeitites, with some specimens (cat. #s 664-4 and 664-3, see Figure 72) having high concentrations of omphacite and paragonite. The jadeitites and omphacitites were consistent with a Guatemalan source, likely originating from somewhere north of the Motagua Fault Zone in Guatemala; paragonite is not known to exist south of the fault zone (George Harlow, personal communication, 2007). SARI-1052 and the Aklis celt fragment were both jadeitites similar in composition to the celts recovered from Antigua (see Figure 71). Though new jadeitite sources have recently been identified in the Greater Antilles, specifically on Hispaniola and Cuba associated with ophiolite belts and serpentinite – blue schist mélanges, there is enough of a difference in the mineralogy to suggest that these materials were not used to manufacture these artifact specimens (George Harlow, personal communication, 2008).

The greenstone ornaments, on the other hand, were carved out of a variety of materials commonly referred to as social jades, namely nephrite, serpentine, chrysoprase, albitite, and quartzites like fuchsite.

Table 25. Andersen Collection stone objects, and the results of Harlow's study to date.

Cat. #	*Wgt. (g)*	*Andersen Description*	*Harlow Description (X-Ray I.D.)*	*Mass*	*Specific Gravity*

Cat. #	*Wgt. (g)*	*Andersen Description*	*Harlow Description (X-Ray I.D.)*	*Mass*	*Specific Gravity*
2029	7.61	35mm, polished oval bead, single hole, gray green stone.		7.6	2.86
2031	3.11	20mm, polished oval bead, single hole, gray-green stone.			
2030	1.25	15mm, polished oval bead, two holes, pale green stone.		1.3	3.46
831-5	1.98	25mm, red jasper ?, irregular trapezoidal		2.0	2.81
2056-2	1.87	15mm, round, dark (black) polished wood.		1.9	1.12
2056-5	1.43	10mm, rounded, dark green turquoise		1.4	1.73
2056-8	1.16	Pale gray-green jade fragment; replacement for 2015 (carved green stone frog), same material		1.1	3.30
827-15	2.42	Rough turquoise? 3 specimens. Dark green	Quartz, mica (polylithionite), ?		
827-1	1.32	Rough turquoise? 3 specimens	Pseudomalachite		
827 (no lot #)	0.75	Rough turquoise? 3 specimens	Pseudomalachite, malachite, turquoise		
2027	7.09	Rounded, worked turquoise (?) bead, 20mm	Malachite	7.1	5.32
2022	5.54	Whitish-green stone, possible "batrachian" or turtle with round center and incised "grid."			
2023	4.91	Amazonite (?); possible bottom half of frog; see carved shell frogs.			
2017	2.58	Amazonite (?) segmented frog with single drill hole.	Micas, + maybe clinozoisite, albite		
2018	4.12	Amazonite (?); variant of segmented frog with possible flat head.	Micas, + maybe clinozoisite, albite; beads 2016 and 2023 appear to be made of the identical material		
2016	8.62	Amazonite (?), frog-like, flat head with single hole, similar to style from Costa Rica. See # 2023.			

Table 25 — Continued.

Cat. #	*Wgt. (g)*	*Andersen Description*	*Harlow Description (X-Ray I.D.)*	*Mass*	*Specific Gravity*
2024	3.04	Amazonite (?), caterpillar form, with holes drilled through the side	Micas, maybe albite		
2021	1.30	Dark green stone, small segmented frog	Nephrite (tremolite-actinolite)		
2019	2.06	Dark green stone, segmented frog			
815-1	4.67	Reddish-brown flake, possibly chert		4.7	2.19
2050-3	3.88	Dark green cylindrical bead, 18 mm long, broken.	Celadonite	3.9	2.08
840	39.95	"Purple" chert		40.1	2.47
2047-2	2.68	Amethyst bead, 15 mm long, broken			
831-6	3.05	30mm and 20 mm fragments, red jasper.		3.0	3.44
831-7	9.80	30mm fragment of red jasper, 20 mm fragment of red jasper		9.9	2.56
827-2	0.28	Malachite green pebble (10mm long); black and patches of turquoise/unidentified green minerals	Pseudomalachite	2.0	1.43
827-14	8.97	Pale gray-green jade-like stones, #10 elongated oval (35mm long max), #17 rounded sq stone (30mm long), #10 pale green chip (25mm long)	Serpentine (lizardite and chrysotile)	9.0	2.49
827-17	10.65	Pale gray-green jade-like stones, 1 rounded sq stone (30mm)	Quartz, muscovite, ?	10.7	2.61
827-10	1.87	Pale gray-green jade-like stones; 1 elongated oval (35mm max), 1 pale green chip (25mm)	Lizardite, some chlorite-like 14.8 Å phase		
649-6	50.70	Green celt	Jadeite/diopside/omphacite, albite, phengite, analcime?	50.7	3.23
649-1	40.93	Broken green celt, exhausted	Jadeite, albite, analcime	41.0	3.22

Table 25 — Continued.

Cat. #	Wgt. (g)	Andersen Description	Harlow Description (X-Ray I.D.)	Mass	Specific Gravity
664-3	42.63	Green exhausted celts, 2 each	Jadeitite, albite, paragonite	42.7	3.02
664-4	26.78	Green exhausted celts, 2 each	Jadeitite, higher content of omphacite, paragonite	26.8	3.12
609-8	101.17	Green celt		101.3	2.96
639.12	496.04	Large green celt or hammer			
645-8	510.75	Large green exhausted celt			
SARI-01052 (FS # 61.28)	220.9	Reused greenstone celt	Jadeite, albite, analcime, paragonite (?), glaucophane?	209.7	3.18
SARI-01056 (FS # 61.31)	6.8	Greenstone flake	Na-Ca amphibole, calcite, quartz, clinochlore	6.4	3.49
Aklis	39.41	Green celt	Jadeite, lawsonite, albite, analcime?		

The "turquoise" objects (catalog #s 827, 827-1, 827-15, and 2027) were identified as malachite and pseudomalachite, with some turquoise. Malachite and turquoise form in dry climates, weathering from copper ores and often associated with limestone deposits (George Harlow, personal communication 2008). Copper deposits related to arc volcanism are located on Puerto Rico, the Virgin Islands (St. John), and the Lesser Antilles, and Cox and Briggs noted that all copper deposits on Puerto Rico "contain some malachite or azurite" (1973:3). This opens the possibility for a localized, regional source for these materials rather than extremely distant origins such as Brazil, Chile, or Mexico. Copper and Oxygen stable isotopes in turquoise can vary substantially, depending on the latitude of the deposit, so future research could focus on generating baseline geochemical data for these Caribbean deposits.

Finally, Catalog #s 2016, 2017, 2018, 2023, and 2024 were all comprised of a very fine grained micaceous rock, with a reflective sheen similar to moonstone. While a surface inspection revealed similarities with amazonite, chemical analysis is currently being conducted in order to identify the minerals.

SUMMARY

In archaeology, changes in style are governed by complex, interconnected systems. “Styles may be seen as interconnected agents whose existences depend on each other by competition and cooperation” (Bentley and Maschner 2001:38). Interaction between individuals leads to coevolutionary change, and interaction is viewed on the landscape via exchange, the movement of goods, village and community location, and the social relations between them. Increasing variability in the execution of refined, elaborately decorated ceramic wares during the Late Saladoid period is indicative of these broader societal changes. Whether these changes were instigated by changes in the homeland that resulted in the severing of social ties, or processes of increased localization and regionalization is unknown. In the CAS model, disruptions in one area would potentially reverberate throughout the entire system, and the removal of a key node in the network could cause an avalanche of change, breaking links with lesser-connected nodes and leaving smaller networks unconnected to the rest of the system.

Several “new” styles of Saladoid period pottery have been identified via the examination of artifact collections. They include both unique materials used in manufacture, such as clays comprised of large amounts of calcium carbonate, and decorative techniques like cross-brushing of slips on the exterior rims and upper flanges of vessels. These styles may be representative of village-specific practices, or even the actions of individual potters.

Based on the results of the NAA analysis and the comparisons to other geochemical studies on neighboring islands, it appears that pottery production was primarily localized and conducted on island. However, based on the results of testing clays from several eroding guts and the settlement pattern analysis there were three possible centers of Saladoid pottery production that could have potentially turned into hubs within a developing scale-free, small-world network: St. Georges, Cane Bay, and Prosperity. These settlements are located near deep guts that, in the past, would have been reliable sources of fresh water. Local potters today swear on the qualities of these clays from these guts when making their own wares. Only with additional studies of both raw clays and well provenienced pottery sherds will we be able to discern directionality, but as the research stands now it appears that clay acquisition for pottery production for the island, for both utilitarian and refined wares, was confined during the Early Saladoid period to either Prosperity or St. Georges, and possibly during the Late Saladoid period expanded to Cane Bay. Based on the settlement pattern analysis, the Prosperity and Salt River sites, being located on the coast, could have potentially served as interaction and exchange centers. These findings could be expanded to include the Glynn site, once clays from the site are tested.

Pottery was also moved between islands, though it cannot be said at this time at what scale this interaction existed, if ceramic wares were regularly traded items or were simply vessels moved by individuals. Pottery was also moved across individual islands, and was not necessarily manufactured near the villages of use. There is chemical evidence of Hacienda Grande pottery from Puerto Rico made its way to the St. Georges site on St. Croix, while at the same time Crucian pottery was transported to several sites on Eastern Hispaniola and the Maisabel site on Puerto Rico.

The styles of stone ornaments and the materials used in their production are also reflective of these complex, interconnected systems. The styles in which these objects were created are indicative of this shared Arawakan heritage, and are imbued with symbolic meaning and value. The variation in styles, most of which are found in all the Caribbean contexts in which these ornaments are encountered, could have simply been the result of variations in their creation by an individual artist, illustrative of learned practice and action as taught and learned through generations, or outward symbols of membership within a variety of social units. Systematic, detailed studies are needed of all collections of these objects, especially those recovered from the La Hueca/Sorcé site on Vieques, in order to begin to cull out patterns of style and material.

It is also highly significant that these two forms of symbolic stone objects, celts and ornaments, are made of two forms of similar materials: true jadeitite (celts) and a variety of social jades (ornaments), like nephrite, serpentine, albite, and chrysoprase. Regarding the results of the stone study, the importance of the presence of Guatemalan-Motagua Fault Zone jadeitites on St. Croix cannot be overemphasized. The efforts that would have been undertaken to obtain such goods, including turquoise, malachite, and social jades required organization and leadership. The presence of these materials at particular settlements, and evidence for their manufacture, argues for the existence of, at the very least, an emerging ranked society with status attributed to those who could obtain such materials and/or coordinate their movement throughout the region (Stone 1993:142). The presence of such goods in middens, not associated with burials, also supports this contention; these goods could have been the symbolic representations of long distance relations that, upon death, and would have possibly been communally interred signifying the end of a particular set of social relations. These social ranks and status are not necessarily linked or related to other elements of power throughout the social system. Locales of specialized or part-time specialized production are not necessarily the same as places of political control, though they may be intricately interconnected (Rogers 1995:8).

CHAPTER 6

CONCLUSIONS

Throughout this research, problems surrounding assumptions of what defines complexity and egalitarianism have been addressed theoretically. Older presumptions equating complexity with institutionalized social hierarchies were simplistic, and are giving way to new, more dynamic understandings. Namely, as discussed in Chapter 2, that complexity and egalitarianism do not exist as meaningful and distinctive classificatory categories of social organization and integration. Complicating the discussion are the numerous definitions and assumptions of what complexity is, measured with two variables, segregation and centralization (Flannery 1972:409; 1989; Chapman 2003:83).

Complexity is not solely regarded as the emergence and development of institutionalized social inequality or hereditary status in response to external stimuli. Instead, complexity theory, as a body of principles and theories, illustrates how cultural changes are effected by the structures of human networks of interaction, communication, and exchange. Human societies are complex systems, they are scale-free, they are interconnected and interdependent on many scales, they coevolve, and they are adaptive, open and dynamic. Evidence presented in this dissertation from the settlement pattern analysis, the study of shared stylistic traits, and geochemical sourcing of artifacts has illustrated the complex interactions and potential relations that can exist in supposed simple, egalitarian societies.

Societies are defined by their own historical trajectories: a shared, common past and cultural underpinning, mythology, and environmental setting that influences adaptation and innovation. Over time, experience, practice, and physical location both influence and promote cultural innovation and divergence; as people migrate and are exposed to new environments, their forms of social organization, their culture, and their daily practices are created, altered, and adapted. Exchange and interaction networks change over time to accommodate new locales, and ties to the homeland give way to more regional and local networks. New worlds begin to develop as new nodes are established and develop connections to each other. As networks are complex, highly variable structures with many components, nodes that are initially well connected to the system will tend to become better connected, until a breaking point or avalanche occurs somewhere in the system. As values and beliefs change throughout the system, so, too, do the connections as new nodes develop, some rise to prominence, and others “die off.” This is evident for both individual persons within communities, and communities themselves as physical realities existing on a landscape.

The relationships between people, their culture, and environment are similar to that of a feedback loop – one influences the other, which spurns adaptation, alteration, and further impact. This loop is not a return to an assumed state of stasis, however, but represents a continual dynamic process which vacillates between periods of societal and cultural coalescence and divergence. As described earlier, changes in one part of the system can have dramatic effects on the rest of the system through practice and experience.

Beyond this, however, is the notion that complex societies are actually social constructs, and that changes in societal organization and structure are indicative of changes in ideas and innovations as accepted by both individuals and the societal collective (Bee 1974:174).

This research has demonstrated the permeable, flexible nature of tribal or middle range identity and boundary creation and maintenance. Degrees of integration and interaction have been illustrated, varying through time and at differing scales. On local and regional scales during the Early Saladiod period, few links were maintained between communities but there were likely strong links connecting strategically located nodes to other strategic nodes from different islands. This integration is illustrated through nearly homogenous production and decoration of refined earthenwares, namely WOR and ZIC wares. These communities also interacted through long-distance networks for the creation and maintenance of social relations and the movement of materials and goods. Through these interactions a shared cultural heritage was both reinforced and generated while simultaneously unique forms of cultural identity were innovated, realized via symbolic value and meaning as implemented on the landscape and in material culture. As small-worlds began to develop, levels of integration on the local scales began to intensify along shorter but weaker links, while regional interaction strengthened only across a few strong connections.

To address the questions presented in the first chapter, first on a local scale:

1) What forms of socio-political organization were potentially used by Saladoid peoples on St. Croix?

In keeping with the concept of an "Arawakan Ethos," these Saladoid settlers would have likely existed as a tribal form of heterarchy, consisting of individuals of higher and lower status and rank which varied and adapted according to context, history, and practice. Status would have been attributed to skilled political leaders and headmen, and who likely possessed ritual knowledge and skill, therefore power – such as shamans, makers of large sea-worthy canoes, navigators, and skilled craftsmen – who maintained these practices of travel for trade and social interaction. Strong ties would be concentrated along a few networks or lines of interaction.

Leaders, whether they are called Big Men or chieftans, would have achieved power based on their skills for negotiation, coordinating exchange and voyages, their goodness, and knowledge and control of the sacred. Based on the ethnographic literature from Amazonia and the Guianas, social and political power is often associated and embodied in the shaman-chief, who has the mystical knowledge and ability to transfer fertility and production to those who are lacking. In these cases, ritualistic knowledge is economic, and political authority is often monopolized by those with ideological authority. In island societies, social power and status is also wielded by those with maritime knowledge and ideology, including navigation, canoe construction, and the ability to organize long distance voyages. In many instances, the headman/leader would have also been skilled crafters of symbolically valuable goods. Skilled craft producers had the knowledge and ability to control the supernatural, communicate with the ancestors, and create aesthetically beautiful, therefore moral, crafts. While initially these higher status roles could be achieved by many, over time they could evolve into hereditary positions.

Settlements and communities with leaders capable of creating and extending alliances, especially those that coordinated the transportation and exchange of goods and services, would have risen to regional prominence (Redmond 1998). Such a circumstance could possibly explain the rise of the Huecan culture in the Vieques Sound region (Chanlatte Baik 2003). Emerging institutionalized social inequality could have been controlled by descent groups or lineages that eventually gave rise to the hierarchical societies encountered by Columbus. As these hierarchically ranked societies emerged communal ritual and symbolism would have been emphasized over individual symbols of prestige and status (Curet 1996). Eventually, symbols that emphasized and legitimated the power of elite status ranks were created, adopted, and used to reinforce developing social institutions. Access to status symbols would have become restricted, no longer potentially accessible by the general population.

2) Are changes in ceramics — style, manufacture technology, etc. — indicative of localized expressions of regional changes and trends at the end of the Saladoid period on St. Croix?

Evidence was presented for the existence of a vast Arawakan interaction sphere, comprised of a shared heritage evident in patterns of settlement, food production and acquisition, a strong focus on long distance and cross-cultural exchange and trade, and stylistic similarities in regards to pottery production and decoration, symbology of pottery, carved shell, and carved stone decorative elements and attributes. Saladoid settlers on St. Croix were most likely frontier members within this network. These peoples, both on St. Croix and elsewhere throughout the Caribbean, represented not a single ethnic group but numerous societies and communities that lived, traveled, and interacted across northeastern South America and Lowland Amazonia. These interactions and the movement of goods throughout the region, especially those regarded with high symbolic value, were likely driven by economic and political means, and aided in the maintenance of senses of ethnic and social identity, evidenced by both a shared cultural heritage, symbology, ritual and ceremony and by efforts undertaken to continue and maintain contacts with others.

Similarities in decorative and stylistic elements are not solely possible indicators of physical migrations from a common point of origin, but also of shared symbolic heritage and value communicated through relations between individuals and communities at multiple scales. Variability in the performance and execution of style and decorative attributes results from social interaction, and demonstrates the creation, development, and maintenance of social boundaries. Ethnic and social identities within these interaction spheres would have been evidenced and maintained symbolically through the use and production of finely decorated pottery, like WOR and ZIC wares, and symbolically valuable stone items, in addition to any perishable items such as baskets, feather headdresses, and other goods (as discussed in Chapter 3). These decorative elements changed over time as did ideas surrounding what was considered to be valuable symbols of group membership, knowledge, and status, via processes of ethnogenesis on both local and regional scales. These changes are also observed in the maintenance and cessation of long distance ties that transported these materials across the Circum-Caribbean region within and between various interaction spheres.

3) What roles do exchange systems play in island colonization, settlement, and the maintenance of social relations and changes in organizational structures, especially along archipelagos that can be tied to a “homeland?” And, 4) how do these roles change over time, as colonies transition into established settlements?

As proposed by the Mercantile Model of Settlement, peoples that settle in a new area bring with them behaviors, beliefs, and practices. Roles are quickly established, and links are maintained with the homeland while, over time, central places develop in the newly settled region. If the settlers encounter new social groups in these new regions, there are several possible outcomes – they could interact peaceably, they could fight, or they could coexist without interaction by separating into distinctly bounded territories.

Following the CAS model, small-worlds began to form in which local links of shorter distances were established between clusters in the newly-developing regional network of the northern Lesser Antilles (Leewards)-Puerto Rico-Eastern Hispaniola region. The CAS eventually evolved to a critical state via multiple dynamic interactions. The initial Crucian settlements in each drainage developed into small hubs, connecting these newer communities into the larger system. A pattern of relations between better connected villages, located near the mouths of rivers and junctions with smaller streams, and lesser connected communities at the headwaters could also be explained as nodes in interaction networks in developing scale-free networks in small-worlds, where many smaller agents are connected to each other through a few higher ranked communities. This pattern could also apply to individual agents, whether shamans and religious leaders and healers, skilled craftsmen who made fine ornaments or canoes, or village leaders and headmen who would have facilitated long distance voyages living in these well-connected nodes.

Some villages involved in the transportation of materials may have been regarded with greater importance due to their geographic location and access to reliable food sources, becoming well connected nodes (Earle 2002 [1977], 1987a, 1987b; Hirth 1996, 1984, 1978; Watters and Rouse 1989). Other villages on other islands, located throughout the Arawakan frontier, would have acted as interaction zones between the developing cultural spheres of the Greater Antilles, the Lesser Antilles, and lowland Amazonia and Orinoquia, and potentially with the Isthmo-Colombian region. Over time, villages located on particular islands would have become renowned for their skill and artistry in the production of particular objects, while others would have became centers of distribution and exchange. Key nodes in such exchange systems could maintain their status even as the greater cultural system underwent massive changes. Additionally, the importance of sacred geography in the ritual and ceremonial lives of these peoples should not be underestimated, in that it is possible that a heterarchical organization of settlement based not solely on proximity to and control of particular resources but on their placement in the landscape as described in creation and culture hero myths could have existed. However, if a key node undergoes a substantial change the resulting effect would ripple throughout the system in a number of possible ways, some catastrophically and others with minimal effect.

The placement of settlements on the landscape is also indicative of socio-political organizational strategies. Site selection, building placement, patterns of settlement, and architectural style are not only pragmatic choices but are material insights into worldviews and cosmological principles of order and structure. These principles and worldviews are illustrated in both objects of symbolic value, regarded with prestige and even considered sacred, and the status of the individuals responsible for their creation, transportation, and acquisition.

The Arawakan-Saladoid interaction sphere is presented as demonstrative of heterarchy, being tribal, House, middle-range, or emerging ranked societies with the following caveats: that "tribe" is not an evolutionary stage, that these societies are not autonomous, isolated, or geographically bounded, and that they are parts of larger interaction systems on local, regional, and macro-regional scales. It is also not assumed that tribal heterarchy represents a singular form of socio-political organization, but is inclusive of a great diversity of organizational forms and strategies largely influenced by localized interactions of individuals, the forms of organization and intricate, complex systems of interaction present in the homeland that were brought with the first colonists and later arrivals, and the local environments in which they settled.

The Proposed Model

The evidence presented in this dissertation supports a pattern of "tribal cycling," as defined by Anderson and Parkinson, for the prehistoric Caribbean. Archaeologically, this is observed in changes in the distribution of material culture and settlement patterning as manifestations of societal transformations, the physical evidence of both small and large tipping points. When the first Saladoid colonizers arrived to the islands of the northern Lesser Antilles, Puerto Rico, and eastern Hispaniola, they were part of the larger Arawakan expansion of networks of tribal, middle-range, or House societies, bound together via interdependent exchange and communication relations and flexibility in forms of socio-political organization. This is evident through the distribution of both ceramic style and form, and raw stone materials, each representative of different spheres of exchange. It is possible that these patterns are indicative of House associations, with various ancestries, clan and moiety affiliations. Ceremonial exchanges of finely crafted ceramic wares and carved stone ornaments, and perhaps perishable goods like baskets and other woven objects would have been affiliated with particular Houses. Many more archaeological investigations should be conducted on both St. Croix and across the Caribbean in order to better address these possibilities. These forms of socio-political organization are also possibly evident through differential burial customs that placed individuals in either centralized cemeteries or surrounding middens, and in some instances both. Those individuals of higher status could have been interred in the centers of ceremonial plazas, while those of lesser status were placed in the outer regions, a pattern observed among modern Amerindian groups in Lowland Amazonia (as discussed in Chapter 3).

On St. Croix, some communities were strategically established along paths of transportation and communication, on both local and regional scales. The island's initial settlements were established in areas where lowland Amazonian and Orinoquian lifeways could be continued; that is, horticulture and gardening, with easy access to the seashore for fish, crabs, and other marine resources. The dendritic and aquatic nature of interisland networks followed the riverine and deltaic patterns brought with them from Lowland Amazonia, and were continued in intraisland patterns of settlement where villages were established up watersheds following initial colonization near watershed mouths and along the coasts. Well connected coastal settlements would have served as hubs linking the island's residents to others throughout the region via long distance relations. These settlements also likely included a territory that encompassed an entire drainage system that could have acted simultaneously as political boundaries. These initial settlements remained important as centers throughout the Saladoid and Early Ostionoid periods, continuing Saladoid-era beliefs and practices and signifying membership within the regional interaction sphere.

At the end of the Prosperity phase links that had focused on interisland and long distance relations began to transition toward intraisland interactions, as new nodes or settlements were established within each drainage. Over time, and as village populations grew, hilltop residences were established that were quite possibly defensive locales, especially on the hills above Salt River Bay. By ca. A.D. 600, the oldest villages were "budding off" and neighboring communities were developing. During this same time, however, the technology of creating and decorating ceramics was "devolving." As presented by the rank-size distributions and path distance analyses, the initial settlements demonstrate a convex distribution, with little economic and political integration and/or the pooling of two or more settlements systems in close proximity. By ca. A.D. 400-600, a double-convex distribution is evident, possibly indicating the presence of two forms of settlement and the development of a central place-like system of interaction and relations.

The St. Georges site, located along Mint Gut and accessible to other settlements by either overland routes or by entering Mint Gut at the coast, would have been a well-connected hub, potentially linking the settlements of the Creque Dam-La Grange drainage with the Salt River drainage. The coastal villages of the eastern half of St. Croix could have accessed St. George by either low-cost overland routes or by following the coastline and entering its drainage system (Mint Gut) near the Enfield Green site. However, these communities demonstrate a distinctive form of settlement, connecting to only one or two nearby settlements along coastal paths. Only a single least cost path was proposed by the GIS that cross-cut the East End Range.

By ca. A.D. 600, the entire region entered a downward trend of a cyclical trajectory, with new societies and communities emerging through processes of societal development, interaction, adaptation, and innovation: ethnogenesis. Exchange and interaction networks were deteriorating, possibly due to several reasons. First, the Saladoid "homeland" in South America was changing; new cultures were developing and possibly new peoples were migrating into the area, disrupting Arawakan exchange networks and interaction ties. It is also known that during this time the Circum-Caribbean area was undergoing a period of climatic drought, but the degree to which this environmental drying impacted societies is unknown. These changes would have a ripple effect throughout the sphere of influence, even to the Caribbean frontier. When coupled with the development of scale-free networks, localized interaction networks began to form. These changes are evidenced by the declining quality of WOR wares and their decoration, and the end of production of ZIC wares. The downward turns of these cycles are representative of tipping points at the edge of chaos, where societies reorganize and self-define. “Devolutions” or supposed “dark ages,” periods when the quality and standardization of prestigious, symbolically valued goods declines and aggregate villages disperse, can be explained as large avalanches of change.

It is difficult to correlate the compositional grouping of artifacts to forms of social organization and units of production. While chemical analysis of ceramics may be shown to correspond to distinctive populations and communities, just how those communities were organized and what modes of production were utilized may not be apparent (Costin 2000:386). Stylistic variability may correlate to different political groupings and alliances. Adding to these complexities is the reality that changes in what is produced as a valuable good (shifts from refined ceramics to ornately carved three-pointer stones, for example) do not necessarily correlate to changes in social organization and modes of production. They are indicative of changes in conceptions of value and the sacred.

Long distance exchange relations of the Saladoid period on St. Croix are evident from the Prosperity, Richmond, and Salt River sites. As presented in Chapter 5, localized interactions are indicated by the likely production of both WOR and ZIC wares from clays present at only three sites occupied during the Saladoid period: Cane Bay, St. Georges, and Prosperity, all located on Glynn soils. The placement of St. Georges near the center of the island, near the confluence of two watersheds and the convergence of the Kingshill Plain with the Blue Mountain range, argues for its role as the most likely center of pottery production for the island. However, it is possible that wares were also made at other communities also located on Glynn soils, including Halfpenny/Manchenil, Prosperity, and Cane Bay, and Glynn. There is also no differentiation between the clays used and ceramic style — WOR and ZIC wares, refined and utilitarian wares, hollow forms and griddles. The only differences in clay use and source were found with two sherds recovered from St. Georges that likely originated from Puerto Rico. Whether these examples, in addition to the Crucian wares recovered from archaeological sites on both Puerto Rico and the Dominican Republic, represent unique social interactions (i.e. wares brought to a community by an individual via trade, marriage, or some other means) or are the first signs, beyond stylistic similarities, of the physical interisland movement of ceramics has yet to be determined.

The Prosperity site has long been assumed as a likely center of production for valuables, primarily of stone ornaments carved into the variety of animal shapes found throughout the macroregion. Geochemical data for stone celts and axes, beads, ornaments, and unworked materials revealed that a variety of objects were transported to the island, and that, most likely, a community or village-based mode of production resulted in the production of these goods. Based on the settlement pattern analysis, the Salt River site was likely a well-connected node linking communities on St. Croix to other communities throughout the multi-island interaction sphere. While there was evidence in the collections studied that shell tools, ornaments, and vomit spatulas were produced here, Salt River was most likely a point of distribution and ceremonial center.

It is important to emphasize that the movement of a people is not equivalent to the wholesale transportation of material culture and language by a single society, and *vice versa*. As illustrated in Chapter 3, there are many instances of multilingualism and multiethnicity within communities, and “even households can interact with other groups independently from the rest of their culture” (Curet 2005:79). With questions surrounding the La Hueca debate still unanswered, the possibility of two or more settlement patterns present during certain chronological periods could be explained by the presence more than one cultural group corresiding at a particular settlement, or in quick succession. The potential for multiethnic villages (or at least societies with various historical ancestries co-residing at particular settlements) exists, and could potentially explain the presence of Huecan materials for at least one site, Prosperity. It could also explain the presence of possible multiple patterns of settlement occurring contemporary to each other.

The possible ties with Isthmo-Colombian and Guatemalan societies, spanning from ca. 500 B.C. to A.D. 500, are both intriguing and significant. As described by Rodriguez Ramos (2007) and Harlow (personal communication 2007), there appears to be a clockwise movement of valued stone materials throughout the Circum-Caribbean area, though some Guatemalan jadeites did end up in Costa Rica (moving the opposite direction). The fact that these Guatemalan jades are present at the earliest Saladoid/Huecan settlements in the West Indies begs the following assumption: regional patterns of acquisition and exchange existed prior to the physical movement of Saladoid/Huecan peoples onto the Caribbean islands. The carving of these Guatemalan and other nonlocal stone materials into Northern Amazonian forms indicates the closer affinity with homeland beliefs and systems of symbolism, while simultaneously the movement of materials through the region. These specific routes, however, have yet to be identified. Whether the Guatemalan jadeitites were transported via direct relations or moved along down-the-line links is unknown. The continued production of finely made ceramic wares in the traditions and styles of the Middle and Lower Orinoco, with possible influences from the llanos, the Caribbean coast of

Colombia, and the Guianas for ZIC wares not only supports the regional interaction model but also advocates the possibility for the presence of multiethnic communities or settlements (Gassón 2002). While the evidence presented in this dissertation and elsewhere (Rodriguez Ramos 2007) appears to bolster the contention that the La Hueca and Saladoid traits represent separate cultural groups, caution should be used until additional definitive studies have been conducted.

DIRECTIONS FOR THE FUTURE

This research expands the Caribbean archaeological scholarship as established by Irving Rouse (1960, 1961, 1964, 1986, 1989, 1992; Rouse and Alegría 1990; Rouse and Allaire 1978), which itself was an expansion of the regional chronology established by Gudmond Hatt in the 1920s. Over the last 30 years, new information has been gathered that has greatly refined the region's chronology. More recently, the works of Peter Siegel (1989, 1992, 1996) at the Maisabel site, Antonio Curet (1992b) at the Valley of Maunabo, Miguel Rodriguez (1991) at Punta Candelero, and Chanlatte Baik (2003) at Sorcé have expanded the interpretive parameters regarding Caribbean settlement patterns and belief systems. The recent research by Rodriguez Ramos (2007) tested Rouse's original assumptions and illustrated how 1) pottery styles do not necessarily equate distinct social units, and 2) how change and/or continuity of pottery styles and decoration, in addition to lithic traditions, do not necessarily equate with the emergence and transitions in socio-political forms. However, nearly all of this work has been conducted on Puerto Rico and the island of Vieques. Archaeologists from the University of Leiden, Netherlands, have been conducting field work on several islands of the northern Lesser Antilles, including Anguilla, Saba, Guadeloupe, St. Martin, and Antigua. Previous work conducted in the Virgin Islands by Gary Vescelius (1952), Ripley Bullen (1962), and Birgit Faber Morse (1989, 1990, 1997), among others, largely built upon the works of Rouse. The Tutu site, excavated by Elizabeth Righter (2002) has been the most comprehensive excavation of a prehistoric village in the Virgin Islands to date.

This research represents one of the first compilations of detailed physiographic, geological, and archaeological data in an attempt to locate potential sources of clays, tempering agents, and lithic materials used in exchange and circulation networks. Both micro- and macro-regional scales of investigation should be incorporated, potentially encompassing the entire Caribbean basin as there is now evidence for long distance interactions with, minimally, the Motagua Valley, Guatemala, and potentially the Isthmo-Colombian region. In order to test these hypotheses of multiple levels or spheres of exchange, baseline geochemical data needs to be generated; on this front, this task has begun. The few studies that have been conducted, on both pottery/clays and stone objects, have shed light on these potential interaction spheres as being both extensive and dynamic. Researchers can begin to focus not solely on the organization of networks and variation via settlement location on the landscape, but actually follow the movement of goods throughout the system as has been done in other island systems. Only then can the nature of these social relations be discussed. The restricted use of these two forms of "greenstone" or "jades" should also be explored in future studies.

Regarding the testing and applicability of the tenets of Complexity Theory for archaeology, there should be a complete, systematic, and consistent inventory and analyses of artifact styles, types, and traits, in order to better understand changes over time. Styles can be likened to agents – "they are adaptive, and changes can trigger their own avalanches" (Bentley and Maschner 2001:50). Artifact and stylistic life spans should be conducted, through the lense of complexity, to elucidate if pottery traits demonstrate material correlates between cultural processes of self-organization, coevolution, and criticality. However, when these studies are conducted they must include data from all components of a system (or as many as possible), including those elements that were unsuccessful and short-lived, such as decorative traits on ceramics that died off or were not widely distributed. This entails a refocus of attention away from external forces of change to interaction and internal innovations, and processes of ethnogenesis as they influence which stylistic elements are continued, altered, and dropped. However, it must be remembered that ceramics, and style, do not necessarily equal society or distinct social units. The distribution, continuity, and coexistence of stylistic attributes, patterns of settlement, and the social relations needed to obtain materials from distant places, as illustrated by Rodriguez Ramos (2007) for Puerto Rico, are indicative of a shared cultural heritage and conceptions of value, evidenced in symbolism used on particular objects as a kind of symbolic capital. This heritage is not necessarily derived from a singular cultural group or society or representative of a single migration, but emerges regionally as multiple interethnic interactions and exchange networks. Caribbean archaeology is now poised to begin addressing these topics, with new evidence being continually uncovered that illuminates the potential interactions, influences, and innovations of and between Archaic and Early Saladoid groups, their descendants, and others throughout the Circum-Caribbean region.

Specifically regarding future archaeology on St. Croix, research should concentrate on interior village sites to investigate the possible roles of seasonal dry and wet cycles in patterns of planting and harvesting, settlement, the possible socio-economic and political relations between interior and shoreline communities, and possible ritual cycles. Paleoenvironmental studies should be conducted in order to establish a baseline for the original and native vegetation, to identify climatic changes that could have affected human behavior and organizational structures, and potentially reveal the impacts of human activities on local environments.

On a final note, additional radiometric dates are needed for the island, especially for Early Ceramic/Saladoid period sites, in order to refine the local chronology which has long been based on timelines developed for neighboring islands (i.e. Puerto Rico) assumptions of parallel development within the culture-historical paradigm. As of this writing, there are no dates earlier than ca. A.D. 410 on the island (see Appendix D). The recent discovery of a possible Archaic-age site in the upper Salt River watershed illustrates just how much of the island's past remains to be unearthed. The presence of early, non-Saladoid period migrants or colonists on the island could support new ideas in the region of localized cultural innovation and development while simultaneously maintaining regional social identities. Only the future can hope to show us the dynamic and complex stories of the past.

APPENDIX A. POTTERY SAMPLES USED IN NAA TESTING.

Sample #	*Catalog #*	*Site Name*	*Group #*	*Description*
1	124	Judith's Fancy (12VAm1-5)	Unassigned	Rim, slipped and smoothed, coarse sand temper
2	206	Judith's Fancy (12VAm1-5)	Unassigned	
3	274	Judith's Fancy (12VAm1-5)	Group 2	Griddle, rim style D, smoothed, grit and sand temper
4	275	Judith's Fancy (12VAm1-5)	Group 2	Griddle, rim style E, smoothed, grit and coarse sand and quartz temper
5	278	Judith's Fancy (12VAm1-5)	Group 2	Carinated bowl, body sherd, slipped and burnished, sand temper
6	352	Judith's Fancy (12VAm1-5)	Unassigned	Unidentified form, red film in zones, body sherd, slipped and smoothed, grog, sand, and shell temper
7	425	Judith's Fancy (12VAm1-5)	Group 2	Bowl with an outflaring rim, slipped, smoothed, burnished, sand temper
8	452	Judith's Fancy (12VAm1-5)	Group 2	Griddle, rim style E, smoothed, coarse sand temper
9	506	Judith's Fancy (12VAm1-5)	Group 2	Bowl, body sherds, reddish-brown slip, smoothed and burnished, sand temper
10	507	Judith's Fancy (12VAm1-5)	Group 2	Griddle, body sherd, grit and coarse sand temper, smoothed
11	554	Judith's Fancy (12VAm1-5)	Group 2	Bowl, rim, slipped and smoothed, sand temper
12	558	Judith's Fancy (12VAm1-5)	Group 2	Bowl, outflaring and ticked rim, slipped, smoothed, burnished, sand temper
13	565	Judith's Fancy (12VAm1-5)	Group 2	Bowl, thickened broad edge rim, slipped and burnished, sand temper
14	560	Judith's Fancy (12VAm1-5)	Unassigned	Bowl, slightly outflaring rim, slipped, smoothed, burnished, sand and shell temper
15	573	Judith's Fancy (12VAm1-5)	Group 2	Bowl, rounded rim, smoothed, quartz and coarse sand temper
16	594	Judith's Fancy (12VAm1-5)	Group 2	Bowl, body sherd, hornblende, grog, and coarse sand temper
17	595	Judith's Fancy (12VAm1-5)	Group 2	Bowl, smoothed, grit and sand temper
18	607	Judith's Fancy (12VAm1-5)	Unassigned	Bowl, body sherd, orange slipped interior, grog, coarse sand, and shell temper
19	710	Judith's Fancy (12VAm1-5)	Group 2	Bowl, body sherd, sand temper
20	720	Judith's Fancy (12VAm1-5)	Group 2	Griddle, body sherd, grit, sand, and shell temper
21	769	Judith's Fancy (12VAm1-5)	Group 2	Bowl, rim sherd, red filmed, sand temper
22	770	Judith's Fancy (12VAm1-5)	Group 2	Griddle, rim style B, smoothed, coarse sand temper
23	805	Judith's Fancy (12VAm1-5)	Group 2	Bowl, body sherd, sand temper,
24	841	Judith's Fancy (12VAm1-5)	Unassigned	Bowl, inward tapering rim, outflaring vessel, slipped and burnished, sand temper

Sample #	*Catalog #*	*Site Name*	*Group #*	*Description*
25	915	Judith's Fancy (12VAm1-5)	Group 2	Bowl, body sherd, burnished, sand temper
26	958	Judith's Fancy (12VAm1-5)	Group 2	Bowl, rounded rim, slipped, smoothed, and burnished, quartz and sand temper,
27	973	Judith's Fancy (12VAm1-5)	Group 2	Bowl, body sherd, white to light buff, light yellow paste, chalky feel, smoothed, sand temper
28	983	Judith's Fancy (12VAm1-5)	Group 2	Bowl, body sherd, slipped and burnished, sand temper
29	1026	Judith's Fancy (12VAm1-5)	Group 2	Bowl, red film on rim, buff slipped exterior, outward ticked rim, filmed, slipped, and burnished, sand temper
30	1027	Judith's Fancy (12VAm1-5)	Unassigned	Bowl, slightly outflaring rim, burnished, sand temper
31	1031	Judith's Fancy (12VAm1-5)	Group 2	Bowl, rounded rim, incurving vessel, slipped and burnished, grit and coarse sand temper
32	1141	Judith's Fancy (12VAm1-5)	Unassigned	Bowl, body sherd, slipped and burnished, sand temper
33	1152	Judith's Fancy (12VAm1-5)	Group 2	Bowl, body sherd, light brown slip, slipped, smoothed, and burnished, sand temper
34	1263	Judith's Fancy (12VAm1-5)	Group 2	Bowl, bilateral rim, slipped, coarse sand temper
35	1312	Judith's Fancy (12VAm1-5)	Group 2	Bowl, slightly outflaring rim, slipped, grit and sand temper
36	1314	Judith's Fancy (12VAm1-5)	Unassigned	Bowl, interior thickened border rim, slightly outflaring, slightly roughened, grit, sand, and shell temper
37	1318	Judith's Fancy (12VAm1-5)	Unassigned	Bowl, slightly concave base, burnished, grit and coarse sand temper
38	1319	Judith's Fancy (12VAm1-5)	Group 2	Bowl, body sherd, buff to light yellow slip, slipped and burnished, sand and shell temper
39	2093	Prosperity (12VAm1-11)	Group 2	Red and "orange" (buff) burnished, incised, and painted bowl; outward flaring rim. Similar to A-291, 29, 361, 62, and 63 (also, A-821, 822).
40	2108	Prosperity (12VAm1-11)	Group 2	Plain buff bowl, yellow-white, chalky feel, tab handles; inward curving globular-like vessel; sooting on interior. Thick ware compared with similar type vessels from St. Georges.
41	2109	Prosperity (12VAm1-11)	Unassigned	WOR; executed well; most likely an inverted bell shape, but small vessel.
42	2114	Prosperity (12VAm1-11)	Unassigned	Brown and white polychrome; white slipped lines are raised; bowl.
43	2125	Salt River (12VAm1-6)	Group 2	Plain reddish-brown slip, lightly burnished, sooted on base exterior; carinated vessel, possibly rim points or leading to an adorno.
44	2126	Salt River (12VAm1-6)	Group 2	
45	2127	Salt River (12VAm1-6)	Group 2	Reddish brown slip, lightly burnished, sooted on base exterior; two appliqued vertical strips with indentations. Similar to Chicoid style, Punta de Garza site, Dominican Republic. See Rouse slide R7912.

Sample #	Catalog #	Site Name	Group #	Description
46	2145	Salt River (12VAm1-6)	Group 2	Applique arms and face ("owl"); inward curving vessel; reddish brown slip with sooting. Similar to Ostionoid style, Macao site, Dominican Republic, and to Boca Chica style, Cucama site, Dominican Republic; See Rouse slide R7877.
47	2163	Windsor (12VAm1-44)	Group 2	Poorly executed WOR (Coral Bay-Longford), some orange-buff slip; inverted bell shape.
48	2164	Windsor (12VAm1-44)	Group 2	Poorly executed WOR, inverted bell shape with D-handle with knob; shallow bowl form.
49	2165	Windsor (12VAm1-44)	Unassigned	Fragment of squared platter. Red and orange slipped, with incised lines in "swastika" like pattern outlining red painted designs on orange field.
50	None	Richmond (12VAm1-4)	Group 2	
51	2230	Richmond (12VAm1-4)	Unassigned	Fragment of bulbous jar similar to A-154. Light buff, slightly chalky feel; small incurving vessel; smoothed, no slip.
52	2238	Richmond (12VAm1-4)		Fragment of oval effigy bowl, yellow slip coat burnished. Possible turtle head, flippers, and tail (Andersen descript.) Light buff to light pink, slightly chalky feel; slightly incurving vessel; smoothed.
53	2383	Glynn (12VAm1-13, 14)	Group 2	Poorly executed WOR, (Coral Bay-Longford); inverted bell shape.
54	2390	Glynn (12VAm1-13, 14)	Group 2	simple, smoothed outflaring rim; sooting; no decoration; dark brown
55	2405	Glynn (12VAm1-13, 14)	Group 2	Small "cup" with straight sides; incised parallel lines in an indeterminate geometric design on exterior; sooting on exterior.
56	2408	Glynn (12VAm1-13, 14)	Group 2	Circular dish with inside painted decoration. Red painted geometric designs, open platter.
57	2454	Richmond or St. Georges	Group 2	Fragments of small bowls, bell and custard cup shapes (Andersen descript.)
58	2464	Richmond or St. Georges	Group 2	Fragments of pottery with "criss-cross" designs and related incised decorations. ZIC ware, dark brown, sooted.
59	2465	Richmond or St. Georges	Group 2	Fragments of pottery with "criss-cross" designs and related incised decorations. ZIC ware, light tan/buff.
60	none	Richmond or St. Georges	Group 2	
61	2607	St. Georges (12VAm1-30)	Group 2	Fragment of gracefully molded oval bowl with duck head adorno with long bill. Rim embellished with wing-like extensions. Red slip/film with slight orange to buff slip, burnished.
62	2644	St. Georges (12VAm1-30)	Group 2	Fragment of large open oval platter reddish-buff slip, smoothed, light burnish, coarse sand.

Sample #	Catalog #	Site Name	Group #	Description
63	2697	St. Georges (12VAm1-30)	Group 2	
64	2736	St. Georges (12VAm1-30)	Group 1	Well-made WOR.
65	2747	St. Georges (12VAm1-30)	Group 2	Fragment of exquisitely bowl with white paint in spiral incisions. Red film, highly burnished/polished, thin.
66	2751	St. Georges (12VAm1-30)	Group 1	Yellow-white, chalky feel, plain, smoothed.
67	2760	St. Georges (12VAm1-30)	Group 2	Simple bowl, some red slip, burnished.
68	2772	St. Georges (12VAm1-30)	Group 2	Two fragments of rare type of cassava griddle, smooth on both sides and suitable for cooking on either side. Both fragments have broken-off lugs, or "leg supports." Red clay.
69	2774	St. Georges (12VAm1-30)	Unassigned	One quarter cassava griddle, underside with imprint of basket or mat.
70	FS # 1	Aklis (12VAm1-42)	Group 2	Griddle fragment (body/base). Underside is unfinished, top is smoothed and slightly roughened. Sooting. Tempers incl grit, coarse sand, feldspar, quartz, possibly fired clay (grog).
71	FS # 2	Aklis (12VAm1-42)	Group 2	Unidentified simple open vessel fragment (body/base/heel). Flat base. Interior is smoothed and sooted. Exterior is rough, with slight remains of red slip on heel. Tempers incl feldspar, quartzite, and possibly volcanics.
72	FS # 3	Aklis (12VAm1-42)	Group 2	Unidentified simple open vessel fragment (body), possibly platter or large open bowl. Both interior and exterior are smoothed, not slipped. Sooting on both the interior and exterior. Tempers incl sand, coarse sand, clay, and possibly feldspar.
73	FS # 4	Aklis (12VAm1-42)	Group 2	Unidentified simple open vessel fragment (body). High fired. Interior has buff slip with some burnishing, exterior has been smoothed and is slightly sooted. Tempers incl fine sand, sand, small quartz.
74	FS # 5	Aklis (12VAm1-42)	Group 2	Unidentified simple large open vessel fragment (body). High fired. Both interior and exterior have buff slip and are burnished (some slip removed from exterior). Tempers incl coarse sand/small grit, quartz, quartzite, shell, poss hematite
75	FS # 6	Aklis (12VAm1-42)	Group 2	Large open platter (rim, body). Flange rim, style 3E, 1A (internal thickened border, rounded). Interior is smoothed and slipped (tool marks?) and burnished. Exterior is smoothed and slipped and lightly burnished with tool marks. Sooting. Tempers incl sand, small bits of hematite (?).
76	Soils / Clays	Aklis	Unassigned	

Sample #	***Catalog #***	***Site Name***	***Group #***	***Description***
77	Soils / Clays	Halfpenny/Manchenil	Group 2	Granard Gut
78	Soils / Clays	Prosperity	Group 2	
79	Soils / Clays	Little La Grange	Group 2	Jolly Hill Gut
80	Soils / Clays	St. Georges	Group 2	Mint Gut
81	Soils / Clays	Bethlehem	Unassigned	
82	Soils / Clays	Caliche	Unassigned	
83	Soils / Clays	Cane Bay	Group 2	Cane Bay Gut
84	Soils / Clays	Judith's Fancy	Unassigned	
85	Soils / Clays	Salt River	Unassigned	
86	Soils / Clays	Mountain Top	Unassigned	St. Thomas

APPENDIX B.

INSTRUMENTAL NEUTRON ACTIVATION ANALYSIS OF LATE SALADOID POTTERY FROM ST. CROIX, U.S. VIRGIN ISLANDS

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Introduction

Pottery (n=73) and clays (n=11) from the island of St. Croix, U.S. Virgin Islands were analyzed by instrumental neutron activation analysis (INAA) at the University of Missouri Research Reactor Center (MURR). Here, we describe sample preparation and analytical techniques used at MURR. Previous research on the island provided a small sample of 50 sherds from Salt River Site allowed for a more robust statistical analysis of the data. The samples from the current project compared well with the previous samples, and in fact, allowed for some revision of the previous chemical group structure. Unfortunately, the vast majority of the samples from the island are assigned to the same chemical group. This suggests that pottery manufactured on St. Croix is quite uniform with regard to elemental composition, and thus production locations on the island are difficult if not impossible to differentiate using the current database.

Sample Preparation

Pottery samples were prepared for INAA using procedures standard at MURR. Fragments of about 1cm^2 were removed from each sample and abraded using a silicon carbide burr in order to remove glaze, slip, paint, and adhering soil, thereby reducing the risk of measuring contamination. The samples were washed in deionized water and allowed to dry in the laboratory. Once dry, the individual sherds were ground to powder in an agate mortar to homogenize the samples. Archival samples were retained from each sherd (when possible) for future research.

Two analytical samples were prepared from each source specimen. Portions of approximately 150 mg of powder were weighed into clean high-density polyethylene vials used for short irradiations at MURR. At the same time, 200 mg of each sample was weighed into clean high-purity quartz vials used for long irradiations. Individual sample weights were recorded to the nearest 0.01 mg using an analytical balance. Both vials were sealed prior to irradiation. Along with the unknown samples, Standards made from National Institute of Standards and Technology (NIST) certified standard reference materials of SRM-1633a (coal fly ash) and SRM-688 (basalt rock) were similarly prepared, as were quality control samples (e.g., standards treated as unknowns) of SRM-278 (obsidian rock) and Ohio Red Clay (a standard developed for in-house applications).

Irradiation and Gamma-Ray Spectroscopy

Neutron activation analysis of ceramics at MURR, which consists of two irradiations and a total of three gamma counts, constitutes a superset of the procedures used at most other NAA laboratories (Glascock 1992; Neff 1992, 2000). As discussed in detail by Glascock (1992), a short irradiation is carried out through the pneumatic tube irradiation system. Samples in the polyvials are sequentially irradiated, two at a time, for five seconds by a neutron flux of 8 x 10^{13} n cm^{-2} s^{-1} The 720-second count yields gamma spectra containing peaks for nine short-lived elements aluminum (Al), barium (Ba), calcium (Ca), dysprosium (Dy), potassium (K), manganese (Mn), sodium (Na), titanium (Ti), and vanadium (V). The samples are encapsulated in quartz vials and are subjected to a 24–hour irradiation at a neutron flux of 5 x 10^{13} n cm^{-2} s^{-1}. This long irradiation is analogous to the single irradiation utilized at most other laboratories. After the long irradiation, samples decay for seven days, and then are counted for 1,800 seconds (the "middle count") on a high-resolution germanium detector coupled to an automatic sample changer. The middle count yields determinations of seven medium half-life elements, namely arsenic (As), lanthanum (La), lutetium (Lu), neodymium (Nd), samarium (Sm), uranium (U), and ytterbium (Yb). After an additional three- or four-week decay, a final count of 8,500 seconds is carried out on each sample. The latter measurement yields the following 17 long half-life elements: cerium (Ce), cobalt (Co), chromium (Cr), cesium (Cs), europium (Eu), iron (Fe), hafnium (Hf), nickel (Ni), rubidium (Rb), antimony (Sb), scandium (Sc), strontium (Sr), tantalum (Ta), terbium (Tb), thorium (Th), zinc (Zn), and zirconium (Zr).

The element concentration data from the three measurements are tabulated in parts per million using the EXCEL spreadsheet program. Descriptive data for the archaeological samples were appended to the concentration spreadsheet. The data are also stored in a dBASE/FOXPRO database file useful for organizing, sorting, and extracting sample information. The data file enclosed with this report contains the sample database in EXCEL format.

Interpreting Chemical Data

The analyses at MURR described previously produced elemental concentration values for 33 elements in most of the analyzed samples. Data for nickel in most samples was below detection limits (as is the norm for most New World ceramic analyses) and was removed from consideration during the statistical analysis. After a microscopic examination of the ceramic and clay samples, we determined that the samples had a high frequency of calcite that may affect the results. Because calcium has the potential to affect (dilute) the concentrations of other elements in the analysis, all samples were mathematically corrected to compensate for any possible calcium included effects (the data were examined before and after calcium correction and the results were similar). The following mathematical correction was used as it has been proven to be effective in other calcium-rich datasets (Cogswell et al. 1998:64; Steponaitis et al. 1988):

$$e' = \frac{10^6 e}{10^6 - 2.5c}$$

where e' is the corrected concentration of a given element in ppm, e is the measured concentration of that element in ppm, and c is the concentration of elemental calcium in ppm. After the calcium correction, statistical analysis was subsequently carried out on base-10 logarithms of concentrations on the remaining 31 elements. Use of log concentrations rather than raw data compensates for differences in magnitude between the major elements, such as calcium, on one hand and trace elements, such as the rare earth or lanthanide elements (REEs). Transformation to base-10 logarithms also yields a more normal distribution for many trace elements.

The interpretation of compositional data obtained from the analysis of archaeological materials is discussed in detail elsewhere (e.g., Baxter and Buck 2000; Bieber et al. 1976; Bishop and Neff 1989; Glascock 1992; Harbottle 1976; Neff 2000) and will only be summarized here. The main goal of data analysis is to identify distinct homogeneous groups within the analytical database. Based on the provenance postulate of Weigand *et al*. (1977), different chemical groups may be assumed to represent geographically restricted sources. For lithic materials such as obsidian, basalt, and cryptocrystalline silicates (e.g., chert, flint, or jasper), raw material samples are frequently collected from known outcrops or secondary deposits and the compositional data obtained on the samples is used to define the source localities or boundaries. The locations of sources can also be inferred by comparing unknown specimens (i.e., ceramic artifacts) to knowns (i.e., clay samples) or by indirect methods such as the "criterion of abundance" (Bishop *et al*. 1992) or by arguments based on geological and sedimentological characteristics (e.g., Steponaitis *et al*. 1996). The ubiquity of ceramic raw materials usually makes it impossible to sample all potential "sources" intensively enough to create groups of knowns to which unknowns can be compared. Lithic sources tend to be more localized and compositionally homogeneous in the case of obsidian or compositionally heterogeneous as is the case for most cherts.

Compositional groups can be viewed as "centers of mass" in the compositional hyperspace described by the measured elemental data. Groups are characterized by the locations of their centroids and the unique relationships (i.e., correlations) between the elements. Decisions about whether to assign a specimen to a particular compositional group are based on the overall probability that the measured concentrations for the specimen could have been obtained from that group.

Initial hypotheses about source-related subgroups in the compositional data can be derived from non-compositional information (e.g., archaeological context, decorative attributes, etc.) or from application of various pattern-recognition technique to the multivariate chemical data. Some of the pattern recognition techniques that have been used to investigate archaeological data sets are cluster analysis (CA), principal components analysis (PCA), and discriminant analysis (DA). Each of the techniques has it own advantages and disadvantages which may depend upon the types and quantity of data available for interpretation.

The variables (measured elements) in archaeological and geological data sets are often correlated and frequently large in number. This makes handling and interpreting patterns within the data difficult. Therefore, it is often useful to transform the original variables into a smaller set of uncorrelated variables in order to make data interpretation easier. Of the above-mentioned pattern recognition techniques, PCA is a technique that transforms from the data from the original correlated variables into uncorrelated variables most easily.

PCA creates a new set of reference axes arranged in decreasing order of variance subsumed. The individual PCs are linear combinations of the original variables. The data can be displayed on combinations of the new axes, just as they can be displayed on the original elemental concentration axes. PCA can be used in a pure pattern-recognition mode, i.e., to search for subgroups in an undifferentiated data set, or in a more evaluative mode, i.e., to assess the coherence of hypothetical groups suggested by other criteria. Generally, compositional differences between specimens can be expected to be larger for specimens in different groups than for specimens in the same group, and this implies that groups should be detectable as distinct areas of high point density on plots of the first few components.

It is well known that PCA of chemical data is scale dependent (Mardia *et al*. 1979), and analyses tend to be dominated by those elements or isotopes for which the concentrations are relatively large. As a result, standardization methods are common to most statistical packages. A common approach it to transform the data into logarithms (e.g., base 10). As an initial step in the PCA of most chemical data at MURR, the data are transformed into log concentrations to equalize the differences in variance between the major elements such as Al, Ca and Fe, on one hand and trace elements, such as the rare-earth elements (REEs), on the other hand. An additional advantage of the transformation is that it appears to produce more nearly normal distributions for the trace elements.

One frequently exploited strength of PCA, discussed by Baxter (1992), Baxter and Buck (2000z), and Neff (1994, 2002), is that it can be applied as a simultaneous R- and Q-mode technique, with both variables (elements) and objects (individual analyzed samples) displayed on the same set of principal component reference axes. A plot using the first two principal components as axes is usually the best possible two-dimensional representation of the correlation or variance-covariance structure within the data set. Small angles between the vectors from the origin to variable coordinates indicate strong positive correlation; angles at 90 degrees indicate no correlation; and angles close to 180 degrees indicate strong negative correlation. Likewise, a plot of sample coordinates on these same axes will be the best two-dimensional representation of Euclidean relations among the samples in log-concentration space (if the PCA was based on the variance-covariance matrix) or standardized log-concentration space (if the PCA was based on the correlation matrix). Displaying both objects and variables on the same plot makes it possible to observe the contributions of specific elements to group separation and to the distinctive shapes of the various groups. Such a plot is commonly referred to as a "biplot" in reference to the simultaneous plotting of objects and variables. The variable inter-relationships inferred from a biplot can be verified directly by inspecting bivariate elemental concentration plots. [Note that a bivariate plot of elemental concentrations is not a biplot.]

Whether a group can be discriminated easily from other groups can be evaluated visually in two dimensions or statistically in multiple dimensions. A metric known as the Mahalanobis distance (or generalized distance) makes it possible to describe the separation between groups or between individual samples and groups on multiple dimensions. The Mahalanobis distance of a specimen from a group centroid (Bieber *et al.* 1976, Bishop and Neff 1989) is defined by:

$$D^2_{y,X} = [y - \overline{X}]^t I_x [y - \overline{X}]$$

where y is the 1 x m array of logged elemental concentrations for the specimen of interest, X is the n x m data matrix of logged concentrations for the group to which the point is being compared with $\overline{X}$ being it 1 x m centroid, and I_x is the inverse of the m x m variance-covariance matrix of group *X*. Because Mahalanobis distance takes into account variances and covariances in the multivariate group it is analogous to expressing distance from a univariate mean in standard deviation units. Like standard deviation units, Mahalanobis distances can be converted into probabilities of group membership for individual specimens. For relatively small sample sizes, it is appropriate to base probabilities on Hotelling's T^2, which is the multivariate extension of the univariate Student's t.

When group sizes are small, Mahalanobis distance-based probabilities can fluctuate dramatically depending upon whether or not each specimen is assumed to be a member of the group to which it is being compared. Harbottle (1976) calls this phenomenon "stretchability" in reference to the tendency of an included specimen to stretch the group in the direction of its own location in elemental concentration space. This problem can be circumvented by cross-validation, that is, by removing each specimen from its presumed group before calculating its own probability of membership (Baxter 1994; Leese and Main 1994). This is a conservative approach to group evaluation that may sometimes exclude true group members.

Small sample and group sizes place further constraints on the use of Mahalanobis distance: with more elements than samples, the group variance-covariance matrix is singular thus rendering calculation of I_x (and D^2 itself) impossible. Therefore, the dimensionality of the groups must somehow be reduced. One approach would be to eliminate elements considered irrelevant or redundant. The problem with this approach is that the investigator's preconceptions about which elements should be discriminate may not be valid. It also squanders the main advantage of multielement analysis, namely the capability to measure a large number of elements. An alternative approach is to calculate Mahalanobis distances with the scores on principal components extracted from the variance-covariance or correlation matrix for the complete data set. This approach entails only the assumption, entirely reasonable in light of the above discussion of PCA, that most group-separating differences should be visible on the first several PCs. Unless a data set is extremely complex, containing numerous distinct groups, using enough components to subsume at least 90% of the total variance in the data can be generally assumed to yield Mahalanobis distances that approximate Mahalanobis distances in full elemental concentration space.

Lastly, Mahalanobis distance calculations are also quite useful for handling missing data (Sayre 1975). When many specimens are analyzed for a large number of elements, it is almost certain that a few element concentrations will be missed for some of the specimens. This occurs most frequently when the concentration for an element is near the detection limit. Rather than eliminate the specimen or the element from consideration, it is possible to substitute a missing value by replacing it with a value that minimizes the Mahalanobis distance for the specimen from the group centroid. Thus, those few specimens which are missing a single concentration value can still be used in group calculations.

Results and Conclusions

Analytical ID numbers

Before examining the results of this study, it is important to note that the analytical identification numbers originally assigned to the samples are identical to those that are reported here. Please see Table 1 for a cross-referenced listing of IDs along with some of the descriptive information for each sample. There are a couple other discrepancies that should be noted. The confusion about the sample numbers developed because the field numbers and the analytical IDs were very similar. Initially the samples were inadvertently prepared using both sets of numbers and then in correcting the sample numbers we discovered a couple problems. First, the sample with field ID number 63C was not included in the shipment, and thus could not be analyzed.

Second, there was a sample with a field ID 60A that was not listed on the spreadsheet sent with the samples. 60A was not analyzed given the absence of descriptive information. For this report, I have used the column of IDs on the far left of Table 1 called "ANID". Please note that there are some differences from the ID numbers initially submitted with the samples. We apologize for any possible confusion and we have taken steps to ensure that this problem does not happen again.

Chemical Group Structure

In order to achieve a more statistically robust sample size, the samples from this project were analyzed along with a previous database of fifty samples from the Salt River site. The previous chemical group structure developed by Christopher Descantes and reported by Glascock et al. (2006) was based primarily on principal component analysis. With the addition of the 84 new samples the two large groups originally reported merged into one large group. Descantes felt that this might happen with a larger sample, and the large group reported here (Group 2) is quite well defined. Neither elemental nor principal component (a summary of the principal component values are listed in Table 2) plots revealed any separation within Group 2. The majority of the sample from the previous project from the Salt River site also fit quite well into the new group. The probability of Group 2 two membership calculated by Mahalanobis distance projections are listed for members of Group1, Group 2, and the unassigned specimens in Table 3. The reference group used to calculate the probability of Group 2 membership in Table 3 included all members of Group 2 from St. Croix, including the samples analyzed in the previous project. Even the sample with the lowest probability of group membership (MYH030) has nearly a ten percent probability of membership. By comparison the two members of Group 1 and the 15 unassigned specimens from this project all have less than a 0.03 percent chance of belonging to Group 2. This strong of a statistical backing of the group structure is rare in pottery studies.

The dominance of Group 2 in the St. Croix assemblage would suggest that members of this group were produced on the island. The clay samples submitted further support this statement. Of the eleven raw clay samples submitted, five fit well in Group 2. A search of all of the Caribbean pottery in the MURR database revealed an interesting pattern. Table 4 lists the probability of membership in Group 2 based on a Mahalanobis distance projection for all Caribbean samples in the MURR database. Datasets from most other islands have no likely members of Group 2, but one sample from Puerto Rico and ten from the Dominican Republic have high probabilities of membership in Group 2. These eleven sherds are quite likely exports from St. Croix and are an interesting avenue for further research.

Group 1 members reveal the opposite pattern of Group 2 members. Descantes assigned three samples to this outlier group in the previous study of St. Croix pottery, and two of the new samples also fit in this group. As shown in Table 3, this is a distinct group from Group 2, at least according to a Mahalanobis distance projection. This group separates according to some elements, as shown in the bivariate plot of scandium and uranium (Figure 1). Members of Group 1 differ from Members of Group 2 primarily in lower concentrations of lower-molecular weight transition metals and higher concentrations of some elements in the lanthanide and actinide series. Much like St. Croix, the pottery sample from Puerto Rico is dominated by a single, probably locally produced, chemical group; Group 4. Figure 2 shows the strong overlap between the Group 4 from Puerto Rico. This link is not as strong as the connection between Group 2 and the samples from the Dominican Republic, but it does suggest a possible source for members of Group 1. None of the clay samples from St. Croix plot consistently within Group 1.

There are 15 samples (18 percent) that remain unassigned. Table 3 shows the very low probability that any of the unassigned specimens belong in Group 2. There is no clear explanation for this, but 18% is not a high percentage of unassigned samples. There were no strong links between any of the unassigned samples and datasets from other islands, so it is not possible to conclude that they are imports, although this is certainly a possibility.

<u>Contextual Patterns</u>

Table 5 breaks down the chemical group assignments by site for both the pottery and clay samples. There are no obvious patterns in this distribution except for the both Group 1 members coming from the same site, but this is a very small sample size to make and significant conclusions. The same lack of patterning is seen in the breakdown by ware type as shown in Table 6.

<u>Conclusions</u>

The pottery sample from St. Croix revealed a surprising uniformity, with the majority of the samples belonging to a single group most likely manufacture on St. Croix. Interestingly, there is some evidence of an export of ceramics to the Dominical Republic, and possibly an import of pottery manufactured in Puerto Rico.

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Table 1: Chemical group assignments and descriptive data for St. Croix pottery and clay samples.

ANID	old anid	field_id	Chem06_JF	site_name	material	ware
MHY001	MHY001	1B	Unassigned	Judith's Fancy	Pottery	Bay-Salt
MHY002	MHY002	2B	Unassigned	Judith's Fancy	Pottery	Bay-Salt
MHY003	MHY003	3B	Group 2	Judith's Fancy	Pottery	ate
MHY004	MHY004	4B	Group 2	Judith's Fancy	Pottery	ate
MHY005	MHY005	5B	Group 2	Judith's Fancy	Pottery	Bay-Salt
MHY006	MHY006	6B	Unassigned	Judith's Fancy	Pottery	Longford
MHY007	MHY007	7B	Group 2	Judith's Fancy	Pottery	Bay-Salt
MHY008	MHY008	8B	Group 2	Judith's Fancy	Pottery	ate
MHY009	MHY009	9B	Group 2	Judith's Fancy	Pottery	Bay-Salt
MHY010	MHY010	10B	Group 2	Judith's Fancy	Pottery	ate
MHY011	MHY011	11B	Group 2	Judith's Fancy	Pottery	Longford
MHY012	MHY012	12B	Group 2	Judith's Fancy	Pottery	Bay-Salt
MHY013	MHY013	13B	Group 2	Judith's Fancy	Pottery	Bay-Salt
MHY014	MHY014	14B	Unassigned	Judith's Fancy	Pottery	Bay-Salt
MHY015	MHY015	15B	Group 2	Judith's Fancy	Pottery	Bay-Salt
MHY016	MHY016	16B	Group 2	Judith's Fancy	Pottery	Bay-Salt
MHY017	MHY017	17B	Group 2	Judith's Fancy	Pottery	Bay-Salt
MHY018	MHY018	18B	Unassigned	Judith's Fancy	Pottery	Bay-Salt
MHY019	MHY019	19B	Group 2	Judith's Fancy	Pottery	Bay-Salt
MHY020	MHY020	20B	Group 2	Judith's Fancy	Pottery	Bay-Salt
MHY021	MHY021	21B	Group 2	Judith's Fancy	Pottery	Longford
MHY022	MHY022	22B	Group 2	Judith's Fancy	Pottery	Bay-Salt
MHY023	MHY023	23B	Group 2	Judith's Fancy	Pottery	Bay-Salt
MHY024	MHY024	24B	Unassigned	Judith's Fancy	Pottery	Longford
MHY025	MHY025	25B	Group 2	Judith's Fancy	Pottery	Bay-Salt
MHY026	MHY026	26B	Group 2	Judith's Fancy	Pottery	Bay-Salt
MHY027	MHY027	27B	Group 2	Judith's Fancy	Pottery	Bay-Salt
MHY028	MHY029	29B	Group 2	Judith's Fancy	Pottery	Bay-Salt
MHY029	MHY030	30B	Unassigned	Judith's Fancy	Pottery	Bay-Salt
MHY030	MHY031	31B	Group 2	Judith's Fancy	Pottery	Bay-Salt
MHY031	MHY032	32B	Unassigned	Judith's Fancy	Pottery	Bay-Salt
MHY032	MHY033	33B	Group 2	Judith's Fancy	Pottery	Longford
MHY033	MHY034	34B	Group 2	Judith's Fancy	Pottery	Bay-Salt
MHY034	MHY035	35B	Group 2	Judith's Fancy	Pottery	Bay-Salt
MHY035	MHY036	36B	Group 2	Judith's Fancy	Pottery	Bay-Salt
MHY036	MHY037B	37B	Unassigned	Judith's Fancy	Pottery	Bay-Salt
MHY037	MHY037C	37C	Unassigned	Judith's Fancy	Pottery	Bay-Salt
MHY038	MHY038	38B	Group 2	Judith's Fancy	Pottery	Bay-Salt

ANID	old anid	field_id	Chem06_JF	site_name	material	ware
MHY039	MHY039	39B	Group 2	Prosperity	Pottery	Prosperity
MHY040	MHY040	40B	Group 2	Prosperity	Pottery	ate
MHY041	MHY041	41B	Unassigned	Prosperity	Pottery	Prosperity
MHY042	MHY042	42B	Unassigned	Prosperity	Pottery	Prosperity
MHY043	MHY043	43B	Group 2	Columbus	Pottery	ate
MHY044	MHY044	44B	Group 2	Columbus	Pottery	ate
MHY045	MHY045	45B	Group 2	Columbus	Pottery	Bay-Salt
MHY046	MHY046	46B	Group 2	Columbus	Pottery	Bay-Salt
MHY047	MHY047	47B	Group 2	Windsor	Pottery	Longford
MHY048	MHY048	48B	Group 2	Windsor	Pottery	Longford
MHY049	MHY049	49B	Unassigned	Windsor	Pottery	Prosperity
MHY050	MHY051	51B	Unassigned	Richmond	Pottery	ate
MHY051	MHY052	52B	Group 2	Richmond	Pottery	ate
MHY052	MHY053	53B	Group 2	Glynn	Pottery	Longford
MHY053	MHY054	54B	Group 2	Glynn	Pottery	ate
MHY054	MHY055	55B	Group 2	Glynn	Pottery	Bay-Salt
MHY055	MHY056	56B	Group 2	Glynn	Pottery	Longford
MHY056	MHY057	57B	Group 2	St. Georges	Pottery	ate
MHY057	MHY058	58B	Group 2	St. Georges	Pottery	Prosperity
MHY058	MHY059	59B	Group 2	St. Georges	Pottery	Prosperity
MHY059	MHY061	61B	Group 2	St. Georges	Pottery	Longford
MHY060	MHY062	62B	Group 2	St. Georges	Pottery	ate
MHY061	MHY063	63B	Group 2	St. Georges	Pottery	Longford
MHY063	MHY064	64B	Group 2	St. Georges	Pottery	Prosperity
MHY064	MHY065	65B	Group 1	St. Georges	Pottery	Prosperity
MHY065	MHY066	66B	Group 2	St. Georges	Pottery	ate
MHY066	MHY067	67B	Group 1	St. Georges	Pottery	Bay-Salt
MHY067	MHY068	68B	Group 2	St. Georges	Pottery	ate
MHY068	MHY069	69B	Unassigned	St. Georges	Pottery	ate
MHY069	MHY070	70B	Group 2	Aklis	Pottery	ate
MHY070	MHY071	71B	Group 2	Aklis	Pottery	ate
MHY071	MHY072	72B	Group 2	Aklis	Pottery	ate
MHY072	MHY073	73B	Group 2	Aklis	Pottery	ate
MHY073	MHY074	74B	Group 2	Aklis	Pottery	ate
MHY074	MHY075	75B	Group 2	Aklis	Pottery	ate
MHY075	MHY076	76B	Unassigned	Aklis	Clay	
MHY076	MHY077	77B	Group 2	Manchenil	Clay	
MHY077	MHY078	78B	Group 2	Prosperity	Clay	
MHY078	MHY079	79B	Group 2	Grange	Clay	
MHY079	MHY080	80B	Group 2	St. Georges	Clay	
MHY080	MHY081	81B	Unassigned	Bethlehem	Clay	

ANID	old anid	field_id	Chem06_JF	site_name	material	ware
MHY081	MHY082	82B	Unassigned	Caliche mine	Clay	
MHY082	MHY083	83B	Group 2	Cane Bay	Clay	
MHY083	MHY084	84B	Unassigned	Judith's Fancy	Clay	
MHY084	MHY085	85B	Unassigned	Columbus	Clay	
MHY085	MHY086	86B	Unassigned	Mountain Top	Clay	

.

Table 2: Table 3: Principal component analysis of St. Croix ceramics (R-Q factor analysis based on variance-covariance matrix).

Principal Components Analysis
Date: 12/11/06

Simultaneous R-Q Factor Analysis Based on Variance-Covariance Matrix

Eigenvalues and Percentage of Variance Explained:

	Eigenvalue	%Variance	Cum. %Var.
1	0.3138	27.5526	27.5526
2	0.2637	23.1598	50.7124
3	0.1109	9.7414	60.4538
4	0.0909	7.9806	68.4344
5	0.0693	6.0823	74.5167
6	0.0457	4.0126	78.5293
7	0.0398	3.4948	82.0241
8	0.0343	3.0109	85.0350
9	0.0275	2.4171	87.4521
10	0.0240	2.1055	89.5576

Eigenvectors (largest to smallest):

As	-0.0355	0.0319	-0.3885	0.1183	0.1770	-0.3765	0.2326	0.2424	-0.5327	0.2236
La	-0.2368	0.1410	0.1231	0.0901	0.1876	0.0966	0.0703	0.0450	-0.0829	-0.1632
Lu	-0.0127	0.1204	-0.0174	-0.1149	0.1838	0.0006	0.0816	-0.0203	0.0897	0.2461
Nd	-0.1321	0.2037	0.0696	0.0083	0.1263	0.2024	0.1458	-0.0658	-0.0280	-0.1114
Sm	-0.0794	0.1841	0.0297	-0.0157	0.1135	0.0544	0.1592	0.0195	0.0111	-0.0780
U	-0.1778	-0.0470	-0.0813	-0.0446	0.0091	0.3936	0.0614	-0.3740	-0.1805	0.3282
Yb	0.0245	0.1441	-0.0384	-0.0931	0.1500	-0.0814	0.1787	0.0578	0.1158	0.1768
Ce	-0.2228	0.1661	0.1437	0.0446	0.1772	0.0802	0.0835	0.1476	-0.0325	-0.1232
Co	0.1340	0.4314	0.0751	0.0666	-0.0241	-0.1225	-0.0379	0.0768	0.0366	-0.0895
Cr	0.0151	0.3425	-0.2001	0.5458	-0.3604	0.2242	-0.2315	0.3098	-0.0103	0.0517
Cs	-0.3175	0.0057	-0.1852	0.1903	0.2724	-0.2588	-0.0407	-0.3322	0.3940	-0.0499
Eu	-0.0307	0.2106	0.0833	-0.0255	0.0904	-0.0096	0.1260	-0.0020	-0.0025	-0.0837
Fe	0.0970	0.2766	-0.0126	-0.1027	-0.0656	0.0416	0.0098	-0.1230	0.0321	-0.0893
Hf	-0.2301	-0.0265	-0.0253	-0.1225	-0.0562	0.0749	0.0230	0.1385	-0.0768	0.3182
Rb	-0.3762	0.0464	0.0668	0.1284	-0.0434	-0.1296	-0.2104	0.0275	0.1472	-0.0026
Sb	-0.0305	0.0057	-0.3645	0.3476	0.1596	-0.1091	-0.1820	-0.3318	-0.0617	0.0961
Sc	0.1413	0.2566	-0.1302	-0.0828	-0.1180	0.0276	0.0601	-0.1354	0.0406	0.1455
Sr	0.0119	0.0375	0.3208	0.0993	-0.0482	-0.1037	0.0492	-0.3705	-0.4144	-0.1281
Ta	-0.1799	0.0725	-0.1369	-0.0813	0.1406	0.3886	-0.1101	-0.0203	-0.0548	-0.1637
Tb	-0.0221	0.1599	-0.0310	-0.0146	0.1713	-0.0713	0.2970	0.1292	0.1120	-0.0608
Th	-0.4272	-0.0394	0.0103	-0.0448	0.0207	0.1457	0.0308	0.2245	-0.1935	-0.1363
Zn	0.0274	0.1563	-0.1576	-0.0939	-0.0299	0.0643	-0.0165	-0.2400	-0.0257	0.0414
Zr	-0.1721	0.0339	0.0500	-0.0981	0.0376	0.1429	-0.2017	0.0964	-0.0879	0.3845
Al	-0.0447	0.0741	-0.0074	-0.1663	-0.0328	0.0566	-0.0430	-0.1317	-0.0447	0.1460
Ba	-0.2951	0.0198	0.1744	0.1268	-0.4983	-0.2380	0.3623	-0.2028	-0.1616	-0.0242
Ca	0.1946	-0.1185	0.4656	0.5477	0.2405	0.2070	0.1742	-0.0259	0.0734	0.3353
Dy	-0.0035	0.1518	-0.0452	-0.0061	0.0704	-0.0202	0.3702	0.0718	0.2286	0.1815
K	-0.2916	0.0672	0.1187	0.0486	-0.0780	-0.1962	-0.1834	-0.0516	0.1701	0.0669
Mn	0.1460	0.3287	0.1420	-0.0494	0.3198	-0.0813	-0.3229	-0.1144	-0.3172	-0.0869
Na	-0.0768	0.1423	0.3506	-0.1979	0.0033	-0.3065	-0.3114	0.1199	0.0102	0.3407
Ti	-0.0341	0.2110	-0.0184	-0.1324	-0.2243	0.1141	0.0902	-0.0919	0.1135	0.0947
V	0.0768	0.2568	-0.0202	-0.0195	-0.1742	-0.0035	0.0513	-0.1372	0.0346	0.1045

Table 3: Mahalanobis distance projection and probabilities of group membership for St. Croix pottery.

MAHALANOBIS DISTANCE CALCULATION FOR MISCELLANEOUS SPECIMENS
PROJECTED AGAINST TWO OR MORE GROUPS.

Reference groups and numbers of specimens:

1	G2	119

Variables used:

AS LA LU ND SM U YB CE CO CR CS EU FE HF RB SB SC SR TA TB TH ZN ZR
AL BA CA DY K MN NA TI V

The following specimens are in the file Group 1

Probabilities:

ID. NO.	G2	BEST GP.
MHY064	0.000	1
MHY066	0.008	1

The following specimens are in the file Group 2

Probabilities:

ID. NO.	G2	BEST GP.
MHY003	98.749	1
MHY004	93.298	1
MHY005	94.821	1
MHY007	91.140	1
MHY008	14.271	1
MHY009	99.809	1
MHY010	99.849	1
MHY011	75.344	1
MHY012	91.792	1
MHY013	99.576	1
MHY015	84.829	1
MHY016	88.884	1
MHY017	90.178	1
MHY019	70.724	1
MHY020	94.885	1
MHY021	99.507	1
MHY022	99.986	1
MHY023	32.036	1
MHY025	94.151	1
MHY026	99.940	1
MHY027	99.712	1
MHY028	99.004	1
MHY030	9.326	1
MHY032	86.802	1
MHY033	72.337	1
MHY034	41.867	1
MHY035	96.171	1
MHY038	95.981	1
MHY039	55.780	1
MHY040	82.582	1
MHY043	92.732	1
MHY044	35.371	1
MHY045	87.298	1
MHY046	87.729	1
MHY047	69.022	1
MHY048	99.069	1
MHY051	73.760	1
MHY052	75.938	1
MHY053	92.544	1
MHY054	98.435	1
MHY055	27.661	1
MHY056	98.836	1
MHY057	87.649	1
MHY058	80.386	1
MHY059	99.188	1
MHY060	98.763	1
MHY061	86.530	1
MHY063	93.468	1
MHY065	18.933	1
MHY067	81.240	1
MHY069	97.891	1
MHY070	81.508	1
MHY071	95.373	1
MHY072	99.073	1

MHY073	91.712	1
MHY074	69.677	1
MHY076	80.359	1

The following specimens are in the file HDYUNAS

	Probabilities:	
ID. NO.	G2	BEST GP.
MHY001	0.000	1
MHY002	0.025	1
MHY006	0.000	1
MHY014	0.027	1
MHY018	0.000	1
MHY024	0.001	1
MHY029	0.024	1
MHY031	0.000	1
MHY036	0.020	1
MHY037	0.000	1
MHY041	0.000	1
MHY042	0.000	1
MHY049	0.000	1
MHY050	0.000	1
MHY068	0.001	1

Summary of Probabilities for Specimens in the file HDYG1

	Probability Cutoff Values:						
Group:	0.01	0.10	1.00	5.00	10.00	20.00	100.00
G2	2	2	2	2	2	2	2

Summary of Probabilities for Specimens in the file HDYG2

	Probability Cutoff Values:						
Group:	0.01	0.10	1.00	5.00	10.00	20.00	100.00
G2	0	0	0	0	1	3	57

Summary of Probabilities for Specimens in the file HDYUNAS

	Probability Cutoff Values:						
Group:	0.01	0.10	1.00	5.00	10.00	20.00	100.00
G2	11	15	15	15	15	15	15

Summary of Best Classification of Projected Specimens:

	Into:	
From:	G2	Total
HDYG1	2	2
HDYG2	57	57
HDYUNAS	15	15
Total	74	74

Table 4: Mahalanobis distance projection and probabilities of St. Croix Group 2 membership for all MURR Carribean samples.

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MAHALANOBIS DISTANCE CALCULATION FOR MISCELLANEOUS SPECIMENS
PROJECTED AGAINST TWO OR MORE GROUPS.

Date:12/15/06
File:lhdy

Reference groups and numbers of specimens:
      1    STCXG2       100
Variables used:
        AS         LA         LU         ND         SM          U         YB
        CE         CO         CR         CS         EU         FE         HF
        RB         SB         SC         SR         TA         TB         TH
        ZN         ZR         AL         BA         CA         DY          K
        MN         NA         TI          V
```

The following specimens are in the file
LANG

ID. NO.	Probabilities: STCXG2	BEST GP.
ANG001	0.000	1
ANG002	0.000	1
ANG003	0.000	1
ANG004	0.000	1
ANG005	0.001	1
ANG006	0.003	1
ANG007	0.000	1
ANG008	0.000	1
ANG009	0.000	1
ANG010	0.000	1
ANG011	0.000	1
ANG012	0.009	1
ANG013	0.000	1
ANG014	0.000	1
ANG015	0.000	1
ANG016	0.000	1
ANG017	0.000	1
ANG018	0.000	1
ANG019	0.000	1
ANG020	0.000	1
ANG021	0.000	1
ANG022	0.000	1
ANG023	0.000	1
ANG024	0.000	1
ANG025	0.000	1
ANG026	0.000	1
ANG027	0.000	1
ANG028	0.000	1
ANG029	0.000	1
ANG030	0.000	1
ANG031	0.000	1
ANG032	0.000	1
ANG033	0.000	1
ANG034	0.143	1
ANG035	0.000	1
ANG036	0.000	1
ANG037	0.000	1
ANG038	0.000	1
ANG039	0.000	1
ANG040	0.000	1
ANG041	0.000	1
ANG042	0.014	1
ANG043	0.000	1
ANG044	0.000	1
ANG045	0.000	1
ANG046	0.000	1
ANG047	0.000	1
ANG048	0.000	1
ANG049	0.000	1
ANG050	0.000	1

The following specimens are in the file
LCANT

ID. NO.	Probabilities: STCXG2	BEST GP.
CANT001	0.000	1
CANT002	0.000	1
CANT003	0.000	1
CANT004	0.000	1
CANT005	0.000	1
CANT006	0.000	1
CANT007	0.002	1
CANT008	0.006	1
CANT009	0.000	1
CANT010	0.000	1
CANT011	0.009	1
CANT012	0.000	1
CANT013	0.000	1
CANT014	0.000	1
CANT015	0.000	1
CANT016	0.000	1
CANT017	0.000	1
CANT018	0.000	1
CANT019	0.000	1
CANT020	0.001	1
CANT021	0.000	1
CANT022	0.002	1
CANT023	0.000	1
CANT024	0.000	1
CANT025	0.000	1
CANT026	0.000	1
CANT027	0.000	1
CANT028	0.000	1
CANT029	0.000	1
CANT030	0.000	1
CANT031	0.000	1
CANT032	0.000	1
CANT033	0.000	1
CANT034	0.001	1
CANT035	0.000	1
CANT036	0.000	1
CANT037	0.000	1
CANT038	0.000	1
CANT039	0.000	1
CANT040	0.000	1
CANT041	0.000	1
CANT042	0.000	1
CANT043	0.000	1
CANT044	0.000	1
CANT045	0.000	1
CANT046	0.000	1
CANT047	0.000	1
CANT048	0.000	1
CANT049	0.000	1
CANT050	0.000	1
CANT051	0.000	1
CANT052	0.000	1
CANT053	0.000	1
CANT054	0.000	1
CANT055	0.000	1
CANT056	0.000	1

CANT057	0.000	1
CANT058	0.000	1
CANT059	0.000	1
CANT060	0.000	1
CANT061	0.000	1
CANT062	0.000	1

The following specimens are in the file
LSMF

	Probabilities:	
ID. NO.	STCXG2	BEST GP.
SMF001	0.000	1
SMF002	0.000	1
SMF003	0.000	1
SMF004	0.000	1
SMF005	0.000	1
SMF006	0.000	1
SMF007	0.000	1
SMF008	0.000	1
SMF009	0.000	1
SMF010	0.000	1
SMF011	0.000	1
SMF012	0.000	1
SMF013	0.000	1
SMF014	0.000	1
SMF015	0.000	1
SMF016	0.000	1
SMF017	0.000	1
SMF018	0.000	1
SMF019	0.000	1
SMF020	0.000	1
SMF021	0.000	1
SMF022	0.000	1
SMF023	0.000	1
SMF024	0.000	1
SMF025	0.000	1
SMF026	0.000	1
SMF027	0.000	1
SMF028	0.000	1
SMF029	0.000	1
SMF030	0.000	1
SMF031	0.000	1
SMF032	0.000	1
SMF033	0.000	1
SMF034	0.000	1
SMF035	0.000	1
SMF036	0.000	1
SMF037	0.000	1
SMF038	0.000	1
SMF039	0.000	1
SMF040	0.000	1
SMF041	0.000	1
SMF042	0.000	1
SMF043	0.000	1
SMF044	0.000	1
SMF045	0.000	1
SMF046	0.000	1
SMF047	0.000	1
SMF048	0.000	1
SMF049	0.000	1
SMF050	0.000	1
SMF051	0.000	1
SMF052	0.000	1
SMF053	0.000	1
SMF054	0.000	1
SMF055	0.000	1
SMF056	0.000	1

The following specimens are in the file
LDOR

	Probabilities:	
ID. NO.	STCXG2	BEST GP.
DOR001	0.000	1
DOR002	0.000	1
DOR003	0.000	1
DOR004	0.000	1
DOR005	0.000	1
DOR006	0.000	1
DOR007	0.000	1
DOR008	0.000	1
DOR009	0.000	1
DOR010	0.000	1
DOR011	0.000	1
DOR012	0.000	1
DOR013	0.000	1
DOR014	0.000	1
DOR015	0.000	1
DOR016	0.000	1
DOR017	0.000	1
DOR018	0.000	1
DOR019	0.000	1
DOR020	0.000	1
DOR021	0.000	1
DOR022	0.000	1
DOR023	0.000	1
DOR024	0.000	1
DOR025	0.000	1
DOR026	0.021	1
DOR027	0.000	1
DOR028	0.000	1
DOR029	0.015	1
DOR030	0.000	1
DOR031	0.000	1
DOR032	0.012	1
DOR033	0.001	1
DOR034	0.000	1
DOR035	0.003	1
DOR036	0.000	1
DOR037	0.000	1
DOR038	0.000	1
DOR039	0.428	1
DOR040	0.000	1
DOR041	0.000	1
DOR042	0.269	1
DOR043	0.000	1
DOR044	1.137	1
DOR045	0.000	1
DOR046	0.000	1
DOR047	0.000	1
DOR048	0.000	1
DOR049	0.000	1
DOR050	0.000	1
DOR051	0.000	1
DOR052	0.000	1
DOR053	0.000	1
DOR054	0.000	1
DOR055	0.000	1
DOR056	0.000	1
DOR057	0.000	1
DOR058	0.000	1
DOR059	0.000	1
DOR060	0.000	1
DOR061	0.000	1
DOR062	0.000	1
DOR063	0.000	1
DOR064	0.000	1
DOR065	0.000	1
DOR066	0.000	1
DOR067	0.000	1
DOR068	0.000	1
DOR069	0.000	1
DOR070	0.000	1
DOR071	0.000	1
DOR072	0.000	1
DOR073	0.000	1
DOR074	0.000	1
DOR075	0.000	1
DOR076	0.000	1
DOR077	0.000	1
DOR078	0.828	1
DOR079	0.000	1
DOR080	0.000	1
DOR081	0.000	1
DOR082	0.000	1
DOR083	0.000	1
DOR084	0.000	1
DOR085	0.000	1
DOR086	0.000	1

DOR087	0.000	1
DOR088	0.000	1
DOR089	0.000	1
DOR090	0.000	1
DOR091	0.000	1
DOR092	0.000	1
DOR093	0.000	1
DOR094	0.000	1
DOR095	0.000	1
DOR096	0.000	1
DOR097	0.025	1
DOR098	0.000	1
DOR099	0.000	1
DOR100	0.000	1
DOR101	0.000	1
DOR102	0.000	1
DOR103	0.000	1
DOR104	0.000	1
DOR105	0.000	1
DOR106	0.000	1
DOR107	0.000	1
DOR108	**15.448**	1
DOR109	0.000	1
DOR110	0.000	1
DOR111	0.000	1
DOR112	0.000	1
DOR113	0.000	1
DOR114	0.000	1
DOR115	0.000	1
DOR116	0.000	1
DOR117	0.000	1
DOR118	0.000	1
DOR119	0.000	1
DOR120	0.000	1
DOR121	0.000	1
DOR122	0.000	1
DOR123	0.000	1
DOR124	0.000	1
DOR125	0.000	1
DOR126	0.000	1
DOR127	0.000	1
DOR128	0.000	1
DOR129	0.006	1
DOR130	1.008	1
DOR131	0.000	1
DOR132	0.000	1
DOR133	0.000	1
DOR134	0.000	1
DOR135	0.000	1
DOR136	0.000	1
DOR137	0.000	1
DOR138	0.000	1
DOR139	0.000	1
DOR140	0.000	1
DOR141	0.000	1
DOR142	0.000	1
DOR143	0.000	1
DOR144	0.000	1
DOR145	0.000	1
DOR146	0.000	1
DOR147	0.000	1
DOR148	0.000	1
DOR149	0.000	1
DOR150	0.000	1
DOR151	**44.437**	1
DOR152	3.291	1
DOR153	0.012	1
DOR154	0.835	1
DOR155	0.000	1
DOR156	**7.655**	1
DOR157	1.100	1
DOR158	**15.054**	1
DOR159	**10.163**	1
DOR160	0.043	1
DOR161	0.716	1
DOR162	0.000	1
DOR163	**44.950**	1
DOR164	**11.029**	1
DOR165	0.000	1
DOR166	0.000	1
DOR167	0.000	1
DOR168	0.001	1
DOR169	**8.811**	1
DOR170	**8.951**	1
DOR171	0.587	1
DOR172	0.000	1
DOR173	0.138	1
DOR174	**12.540**	1
DOR175	0.000	1

The following specimens are in the file LGUA

ID. NO.	Probabilities: STCXG2	BEST GP.
GUA001	0.000	1
GUA002	0.000	1
GUA003	0.000	1
GUA004	0.000	1
GUA005	0.000	1
GUA006	0.000	1
GUA007	0.000	1
GUA008	0.000	1
GUA009	0.000	1
GUA010	0.000	1
GUA011	0.000	1
GUA012	0.000	1
GUA013	0.000	1
GUA014	0.000	1
GUA015	0.000	1
GUA016	0.000	1
GUA017	0.000	1
GUA018	0.000	1
GUA019	0.000	1
GUA020	0.000	1
GUA021	0.000	1
GUA022	0.000	1
GUA023	0.000	1
GUA024	0.000	1
GUA025	0.000	1
GUA026	0.000	1
GUA027	0.000	1
GUA028	0.000	1
GUA029	0.000	1
GUA030	0.000	1
GUA031	0.000	1
GUA032	0.000	1
GUA033	0.000	1
GUA034	0.000	1
GUA035	0.000	1
GUA036	0.000	1
GUA037	0.000	1
GUA038	0.000	1
GUA039	0.000	1
GUA040	0.000	1
GUA041	0.000	1
GUA042	0.000	1
GUA043	0.000	1
GUA044	0.000	1
GUA045	0.000	1
GUA046	0.000	1
GUA047	0.047	1
GUA048	0.000	1
GUA049	0.000	1
GUA050	0.000	1

The following specimens are in the file LJAM

ID. NO.	Probabilities: STCXG2	BEST GP.
JAM001	0.002	1
JAM002	0.000	1
JAM003	0.000	1
JAM004	0.000	1
JAM005	0.000	1
JAM006	0.000	1
JAM007	0.000	1
JAM008	0.005	1
JAM009	0.000	1

JAM010	0.004	1
JAM011	0.000	1
JAM012	0.000	1
JAM013	0.000	1
JAM014	0.000	1
JAM015	0.000	1
JAM016	0.000	1
JAM017	0.000	1
JAM018	0.165	1
JAM019	0.000	1
JAM020	0.000	1
JAM021	0.013	1
JAM022	0.000	1
JAM023	0.003	1
JAM024	0.000	1
JAM025	0.000	1
JAM026	0.000	1
JAM027	0.000	1
JAM028	0.000	1
JAM029	0.000	1
JAM030	0.000	1
JAM031	0.000	1
JAM032	0.000	1
JAM033	0.000	1
JAM034	0.000	1
JAM035	0.000	1
JAM036	0.000	1
JAM037	0.000	1
JAM038	0.000	1
JAM039	0.000	1
JAM040	0.003	1
JAM041	0.000	1
JAM042	0.020	1
JAM043	0.000	1
JAM044	0.000	1
JAM045	0.000	1
JAM046	0.000	1
JAM047	0.000	1
JAM048	0.000	1
JAM049	0.000	1
JAM050	0.000	1
JAM051	0.000	1

The following specimens are in the file LPUR

ID. NO.	Probabilities: STCXG2	BEST GP.
PUR001	0.000	1
PUR002	0.254	1
PUR003	0.000	1
PUR004	0.000	1
PUR005	0.000	1
PUR006	0.000	1
PUR007	0.000	1
PUR008	0.000	1
PUR009	0.018	1
PUR010	0.000	1
PUR011	0.000	1
PUR012	0.000	1
PUR013	0.000	1
PUR014	0.000	1
PUR015	0.000	1
PUR016	0.000	1
PUR017	0.000	1
PUR018	0.000	1
PUR019	0.000	1
PUR020	0.030	1
PUR021	0.000	1
PUR022	0.000	1
PUR023	0.000	1
PUR024	0.001	1
PUR025	0.000	1
PUR026	0.002	1
PUR027	0.000	1
PUR028	0.000	1
PUR029	0.012	1
PUR030	0.000	1
PUR031	0.001	1
PUR032	0.000	1
PUR033	0.000	1
PUR034	0.000	1
PUR035	0.000	1
PUR036	0.000	1
PUR037	**56.507**	**1**
PUR038	0.000	1
PUR039	0.000	1
PUR040	0.001	1
PUR041	0.000	1
PUR042	0.000	1
PUR043	0.000	1
PUR044	0.000	1
PUR045	0.000	1
PUR046	0.000	1
PUR047	0.000	1
PUR048	0.000	1
PUR049	0.000	1
PUR050	0.002	1
PUR051	0.000	1
PUR052	0.000	1
PUR053	0.000	1

The following specimens are in the file LTMA

ID. NO.	Probabilities: STCXG2	BEST GP.
TMA001	0.000	1
TMA002	0.000	1
TMA003	0.000	1
TMA004	0.000	1
TMA005	0.000	1
TMA006	0.000	1
TMA007	0.000	1
TMA008	0.000	1
TMA009	0.000	1
TMA010	0.000	1
TMA011	0.000	1
TMA012	0.000	1
TMA013	0.000	1
TMA014	0.000	1
TMA015	0.000	1
TMA016	0.000	1
TMA017	0.000	1
TMA018	0.000	1
TMA019	0.000	1
TMA020	0.000	1
TMA021	0.000	1
TMA022	0.000	1
TMA023	0.000	1
TMA024	0.002	1
TMA025	0.000	1
TMA026	0.000	1
TMA027	0.000	1
TMA028	0.000	1
TMA029	0.000	1
TMA030	0.000	1
TMA031	0.000	1
TMA032	0.000	1
TMA033	0.000	1
TMA034	0.000	1
TMA035	0.000	1
TMA036	0.000	1
TMA037	0.000	1
TMA038	0.000	1
TMA039	0.000	1
TMA040	0.000	1
TMA041	0.000	1
TMA042	0.000	1
TMA043	0.000	1
TMA044	0.000	1
TMA045	0.000	1

Summary of Probabilities for Specimens in the file LANG

Group:	0.01	0.10	1.00	5.00	10.00	20.00	100.00
STCXG2	48	49	50	50	50	50	50

Probability Cutoff Values:

Summary of Probabilities for Specimens in the file LCANT

Probability Cutoff Values:

Group:	0.01	0.10	1.00	5.00	10.00	20.00	100.00
STCXG2	62	62	62	62	62	62	62

Summary of Probabilities for Specimens in the file LSMF

Probability Cutoff Values:

Group:	0.01	0.10	1.00	5.00	10.00	20.00	100.00
STCXG2	56	56	56	56	56	56	56

Summary of Probabilities for Specimens in the file LDOR

Probability Cutoff Values:

Group:	0.01	0.10	1.00	5.00	10.00	20.00	100.00
STCXG2	148	154	161	165	168	173	175

Summary of Probabilities for Specimens in the file LGUA

Probability Cutoff Values:

Group:	0.01	0.10	1.00	5.00	10.00	20.00	100.00
STCXG2	49	50	50	50	50	50	50

Summary of Probabilities for Specimens in the file LJAM

Probability Cutoff Values:

Group:	0.01	0.10	1.00	5.00	10.00	20.00	100.00
STCXG2	48	50	51	51	51	51	51

Summary of Probabilities for Specimens in the file LPUR

Probability Cutoff Values:

Group:	0.01	0.10	1.00	5.00	10.00	20.00	100.00
STCXG2	48	51	52	52	52	52	53

Summary of Probabilities for Specimens in the file LTMA

Probability Cutoff Values:

Group:	0.01	0.10	1.00	5.00	10.00	20.00	100.00
STCXG2	45	45	45	45	45	45	45

Summary of Best Classification of Projected Specimens:

From:	Into: STCXG2	Total
LANG	50	50
LCANT	62	62
LSMF	56	56
LDOR	175	175
LGUA	50	50
LJAM	51	51
LPUR	53	53
LTMA	45	45
Total	542	542

Table 5: Breakdown of chemical group assignment by site.

Site	Group 1 Pottery	Group 2 Pottery	Unassigned Pottery	Group 2 Clay	Unassigned Clay
Aklis		6			1
Bethlehem					1
Caliche Mine					1
Cave Bay				1	
Columbus		4			1
Glynn		4			
Grange				1	
Judith's Fancy		28	11		1
Manchenil				1	
Mountain Top					1
Prosperity		2	2	1	
Richmond		1	1		
St. Georges	2	9	1	1	
Windsor		2	1		

Table 6: Breakdown of chemical group assignment by ware type.

Ware Type	Group 1 Pottery	Group 2 Pottery	Unassigned Pottery
Ate		19	2
Bay-Salt	1	24	8
Longford		9	2
Prosperity	1	4	3

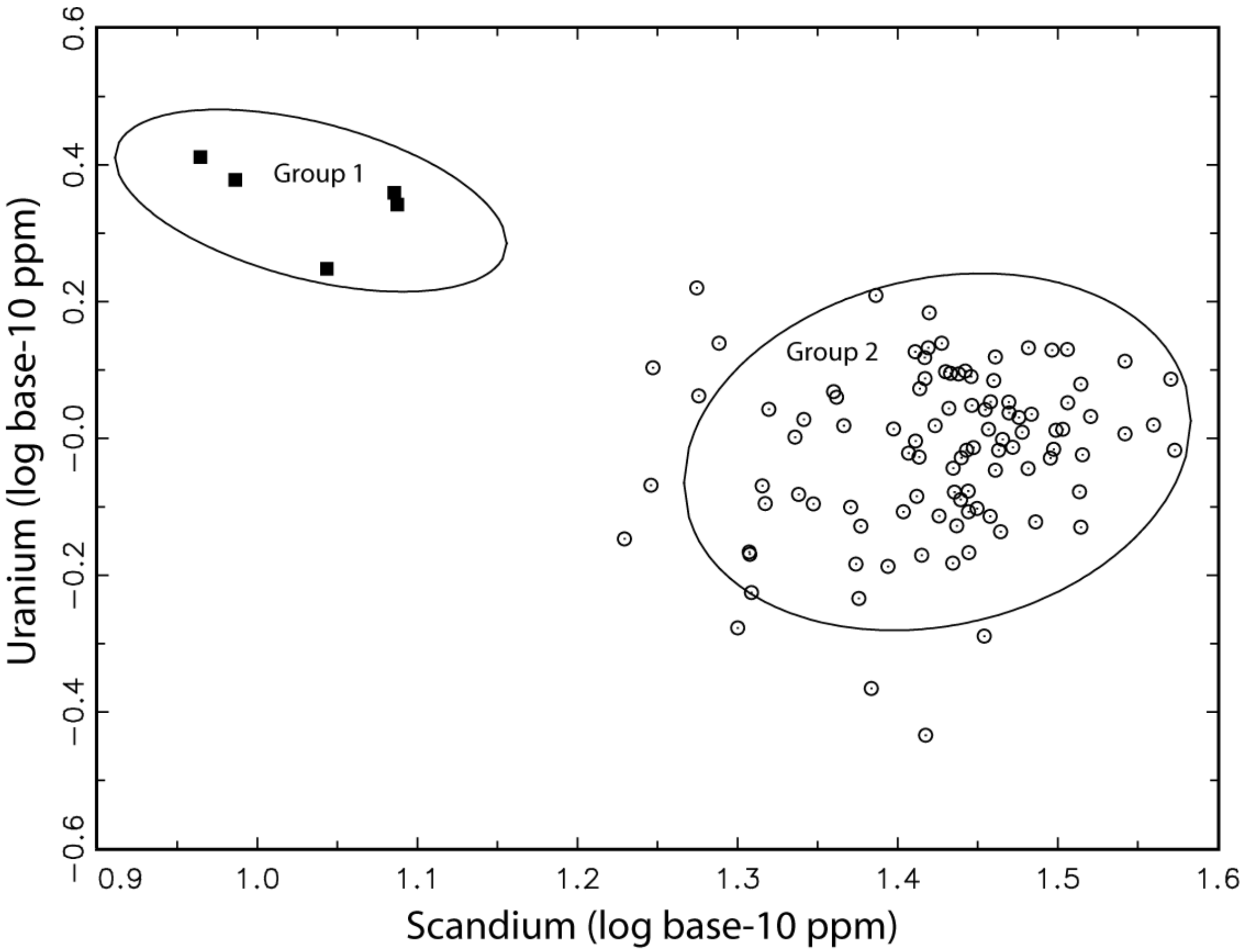

Figure 1. Bivariate plot of scandium and uranium base-10 logged concentrations showing the separation of Groups 1 and 2. Plot includes all members from both projects analyzed from St. Croix. Ellipses represent 90% confidence level for membership in the groups.

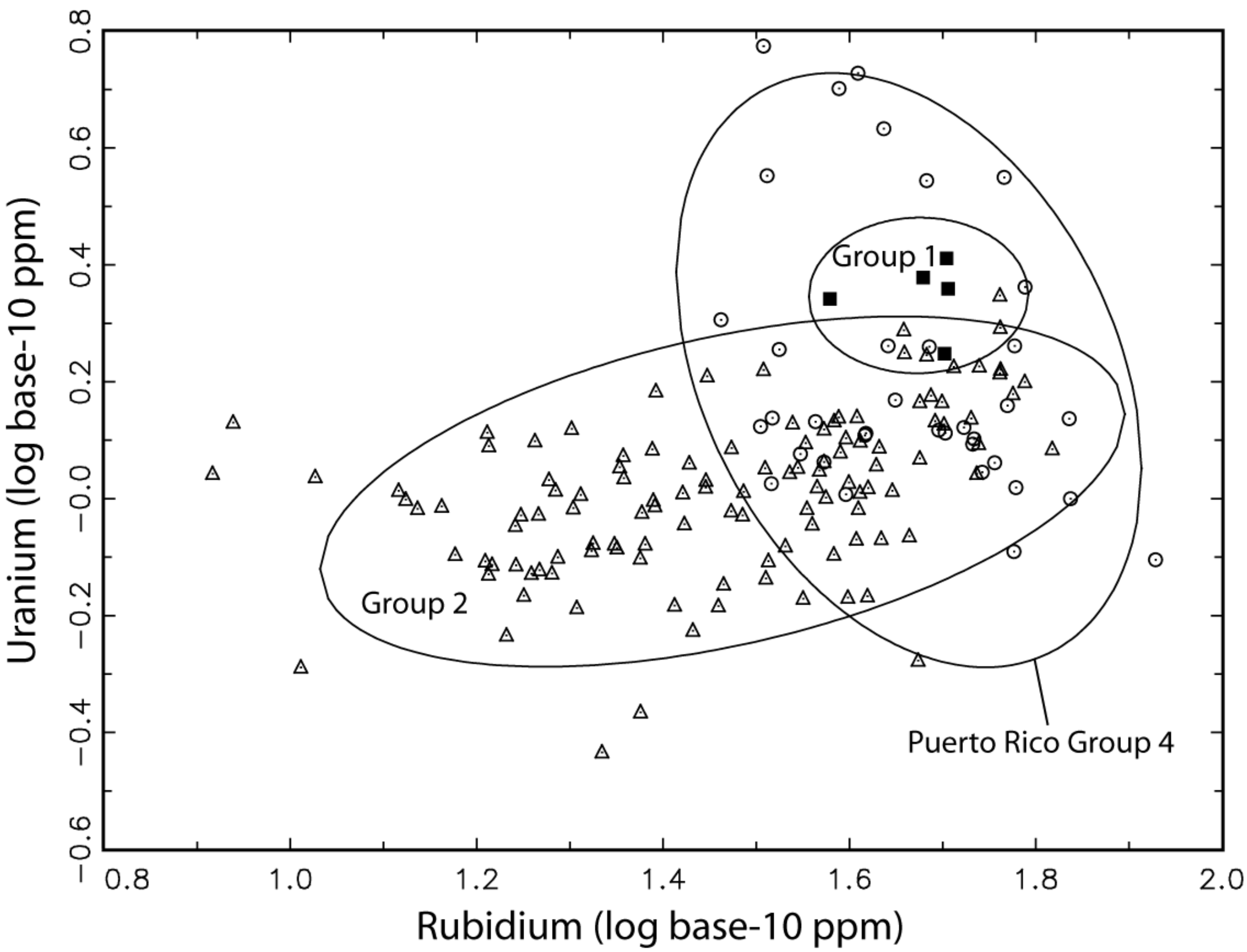

Figure 2. Bivariate plot of rubidium and uranium base-10 logged concentrations showing the similarity between Group 1 from St. Croix and Group 4 from Puerto Rico. Ellipses represent 90% confidence level for membership in the groups.

APPENDIX C. COPYRIGHT PERMISSION FORMS

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Michael D. Glascock

Date: 3/6/08

APPENDIX D. RADIOMETRIC DATES FROM ARCHAEOLOGICAL SITES FROM ACROSS ST. CROIX, AS OF 2008.

Lab. No.	Sample I.D.	Site	Material	Analysis Method	Conventional Age	Measured Radiocarbon Age	13C/13C Ratio	2 Sig Cal	Intercept
Beta – 194510	1853 FS37-01	Buck Island Hearth	Charred wood (acid/alkali/acid)	AMS-Standard Delivery	1560 ±40 BP	1560 ±40 BP	-24.8 o/oo	Cal AD 410 to 600 (Cal BP 1540 to 1350)	Cal AD 530 (Cal BP 1420)
Beta - 194511	1853 FS38-31	Buck Island Hearth	Shell (Cittarium pica) (acid etch)	Radiometric-Standard Delivery	1760 ±70 BP	1310 ±60 BP	+2.0 o/oo	Cal AD 510 to 700 (Cal BP 1440 to 1180)	Cal AD 660 (Cal BP 1290)
Beta – 82566	1-D 0.00-0.10	Aklis*	Shell (conch) (acid etch)	Radiometric-Standard Delivery	1630 ±80 BP	1200 ±70 BP	+0.7 o/oo	Cal AD 635 to 955 (Cal BP 1315 to 995)	Cal AD 765 (Cal BP 1185)
Beta – 82357	Cat # 83.14 Unit 1 Level 5	Aklis*	Shell (conch) (acid etch)	Radiometric-Standard Delivery	1650 ±80 BP	1200 ±70 BP	+2.4 o/oo	Cal AD 615 to 915 (Cal BP 1335 to 1035)	Cal AD 730 (Cal BP 1220)
Beta – 82360	Cat # 560.1 Unit 3 level 2-3	Aklis*	Shell (conch) (acid etch)	Radiometric-Standard Delivery	1500 ±70 BP	1090 ±70 BP	-0.3 o/oo	Cal AD 740 to 1045 (Cal BP 1210 to 905)	Cal AD 910 (Cal BP 1040)
Beta – 82358	Cat # 139.32 Unit 3 Level 7	Aklis*	Shell (conch) (acid etch)	Radiometric-Standard Delivery	1530 ±70 BP	1100 ±70 BP	+0.7 o/oo	Cal AD 710 to 920 (Cal BP 1240 to 920)	Cal AD 880 (Cal BP 1070)
Beta – 82359	Cat # 166.24 Unit 5 Level 2 Quad B	Aklis*	Shell (conch) (acid etch)	Radiometric-Standard Delivery	530 ±70 BP	100 ±70 BP	+1.0 o/oo	Cal AD 1650 to 1950 (Cal BP 300 to 0)	Cal AD 1805 (Cal BP 145)
Not available; before 1992		Aklis**	Human skeletal sample		AD 600				
Not available; before 1992		Judith's Fancy***	Human skeletal sample		1150 ±70 BP			Cal AD 665 to 1015 (Cal BP 1285 to 935)	

Lab. No.	Sample I.D.	Site	Material	Analysis Method	Conventional Age	Measured Radiocarbon Age	13C/13C Ratio	2 Sig Cal	Intercept
Beta – 217564	1	Richmond	Human skeletal sample (bone collagen, collagen extraction with alkali)	AMS-Standard Delivery	1380+/-40 BP	1280+/-40 BP	-18.7 o/oo 15N/14N= +11.8 o/oo	Cal AD 620 to 690 (Cal BP 1330 to 1260)	Cal AD 660 (Cal BP 1290)
Beta – 217565	2	Salt River	Human skeletal sample (bone collagen, collagen extraction with alkali)	AMS Standard Delivery	1190+/-40 BP	1050+/-40 BP	-16.3 o/oo 15N/14N= +15.0 o/oo	Cal AD 720 to 740 (Cal BP 1230 to 1210)	Cal AD 870 (Cal BP 1080)
Beta – 217566	3	Green Cay	Human skeletal sample (bone collagen, collagen extraction with alkali)	AMS-Standard Delivery	1320+/-40 BP	1170+/-40 BP	-15.6 o/oo 15N/14N= +12.1 o/oo	Cal AD 650 to 780 (Cal BP 1300 to 1170)	Cal AD 680 (Cal BP 1270)
Beta – 217567	4	Aklis	Human skeletal sample (bone collagen, collagen extraction with alkali)	AMS-Standard Delivery	1280+/-40 BP	1120+/-40 BP	-15.3 o/oo 15N/14N= +12.8 o/oo	Cal AD 660 to 810 (Cal BP 1280 to 1140); Cal AD 840 to 860 (Cal BP 1110 to 1100)	Cal AD 710 (Cal BP 1240)
Beta – 217568	5	Judith's Fancy	Human skeletal sample (bone collagen, collagen extraction with alkali)	AMS-Standard Delivery	1330+/-40 BP	1150+/-40 BP	-13.8 o/oo 15N/14N= +12.3 o/oo	Cal AD 650 to 770 (Cal BP 1300 to 1180)	Cal AD 680 (Cal BP 1270)
Beta – 209047	SARI1953 4801	Judith's Fancy	Charred wood (acid/alkali/acid)	Radiometric-Standard Delivery	1390 +/- 70 BP	1400 +/- 70 BP	-25.6 o/oo	Cal AD 540 to 770 (Cal BP 1410 to 1180)	
Beta – 209048	SARI1953 5501	Judith's Fancy	Shell (acid etch)	Radiometric-Standard Delivery	1660 +/- 70 BP	1250 +/- 60 BP	-0.1 o/oo	Cal AD 620 to 890 (Cal BP 1330 to 1060)	
Beta – 209049	SARI1953 7701	Judith's Fancy	Human tooth (collagen extraction, with alkali)	AMS-Standard Delivery	1300 +/- 40 BP	1160 +/- 40 BP	-16.2 o/oo 15N/14N= +10.6 o/oo	Cal AD 660 to 790 (Cal BP 1290 to 1160)	

Lab. No.	Sample I.D.	Site	Material	Analysis Method	Conventional Age	Measured Radiocarbon Age	13C/13C Ratio	2 Sig Cal	Intercept
Beta – 209050	SARI1953 8301	Judith's Fancy	Charred wood (acid/alkali/acid)	Radiometric-Standard Delivery (with extended counting)	1420 +/- 60 BP	1430 +/- 60 BP	-25.9 o/oo	Cal AD 540-690 (Cal BP 1410 to 1260)	

* from Hayward and Cinquino 2002:182.
** from Doran 1990. No further information is available, due to Hurricane Andrew, 1992.
*** from Doran 1989. No further information is available, due to Hurricane Andrew, 1992.

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1973 Prehistoric Human Occupations of the Western Venezuelan Llanos. *American Antiquity* 38(2): 182-190.

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1984 The Ceramic Sequence and New TL and C-14 Dates for the Aguerito Site of the Middle Orinoco, Venezuela. *Journal of Field Archaeology* 11(2): 155-180.

BIOGRAPHICAL SKETCH

MEREDITH D. HARDY

Born: August 3, 1972, Natchez, Mississippi.

Education

2008 Doctorate of Philosophy, College of Arts and Sciences, Department of Anthropology, Florida State University, Tallahassee, FL. Dissertation title: *Saladoid Economy and Complexity on the Arawakan Frontier*.

2002 Master of Arts, Department of Anthropology, Florida State University, Tallahassee, FL. Thesis title: *Trinkets and Baubles: Creolization and the Relevance of Glass Beads on an Historic Slave Site, Stafford Plantation, Cumberland Island National Seashore*.

1998 Certificate in Historic Preservation. College of Urban and Public Affairs, University of New Orleans, New Orleans, LA.

1998 Master of Science, Urban Studies and Applied Urban Anthropology, University of New Orleans, New Orleans, LA. Thesis title: *A Question of Origin: Archaeological Evidence of 18th Century Spanish Trading Practices in the New Orleans Colony, Hermann-Grima House 16OR45*.

1994 Double Bachelor of Arts, Anthropology and English, Indiana University, Bloomington, IN.

Experience

04/2002 – Present	Archeologist, Regionwide Archeological Survey Program. National Park Service, Southeast Archeological Center. Tallahassee, FL.
01/2002 – 04/2002	Archeological Technician, Compliance Division. National Park Service, Southeast Archeological Center. Tallahassee, FL.
01/2001 – 08/2001	Archeological Technician, Compliance Division. National Park Service, Southeast Archeological Center. Tallahassee, FL.
08/2000 – 12/2000	Graduate Teaching Assistant, Archaeological Field School, Department of Anthropology, Florida State University.
08/1999 – 05/2001	Graduate Teaching Assistant, Department of Anthropology, Florida State University.

05/1999 – 08/2000 Archeological Technician, Compliance Division. National Park Service, Southeast Archeological Center. Tallahassee, FL.

05/1997 – 08/1998 Lab Specialist. R. Christopher Goodwin and Associates, Inc. New Orleans, LA.

01/1997 – 05/1997 Intern, Vieux Carré Property Owners and Residents Association (VCPORA), through the Department of Urban Planning and Administration, University of New Orleans, New Orleans, LA. Tasks included conducting property and title research, developing fund-raising strategies, monitoring noise levels and compliance to City of New Orleans Council ordinances and rulings, and general administrative duties.

08/1996 – 12/1996 Graduate Research Assistant, Department of Anthropology, University of New Orleans. New Orleans, LA.

Memberships, Honors, Awards, Etc.

Register of Professional Archaeologists
National Trust for Historic Preservation
Society for American Archaeology – Curriculum Committee
Society for Historical Archaeology
International Association for Caribbean Archaeology
World Archaeological Congress
American Anthropological Association
Alpha Theta Epsilon Graduate Honor Society, University of New Orleans

Recipient. Horace M. Albright-Conrad L. Wirth Grant, National Park Service, 2005, for fiscal year 2006. Title: Inventory of Archaeological Materials from the Salt River Bay National Historic Park and Ecological Preserve, Housed at the Yale Peabody Museum, New Haven, CT.

Recipient (with Guy Prentice). Horace M. Albright-Conrad L. Wirth Grant, National Park Service, 2003, for fiscal year 2004. Title: Inventory of Archaeological Materials from the Salt River Bay National Historic Park and Ecological Preserve, Housed at the Danish National Museum, Copenhagen, Denmark.

Papers Presented

2007 The Prehistory and Archaeology of St. Croix and Salt River Bay. Presented to the Virgin Islands National Guard, July 19, 2007. University of the Virgin Islands, St. Croix campus.

2007 The Vescelius Collection, St. Croix Archaeological Survey: a Re-evaluation of the Usefulness of Old Collections. Presented at the 72nd annual meeting of the Society for American Archaeology, April 23-29, 2007, Austin, TX.

2006 Section 110 Survey at Buck Island Reef National Monument and Salt River Bay National Historic Site and Ecological Preserve. Presented at the 71st annual meeting of the Society for American Archaeology, April 26-30, 2006, San Juan, Puerto Rico.

2006 Archaeology and Prehistory of Salt River. Presented at the 18th Annual Conference of the Society of Virgin Islands Historians, January 21 2006, University of the Virgin Islands, St. Croix campus.

2006 Living on the Edge: Early Expressions of Creole Culture on the French Colonial Gulf Coast, Part II. Presented at the 39th annual meeting of the Society of Historical and Underwater Archaeology, January 12-14, 2006, Sacramento, CA.

2004 (with Elizabeth Lee and Michael Galaty). Soil chemistry at the Körösladány-Bikeri (k-14) Site, Békés County, Hungary. Presented at the 69th annual meeting of the Society for American Archaeology, March 31-April 4, 2004, Montreal, Canada.

2004 Living on the Edge: Early Expressions of Creole Culture on the French Colonial Gulf Coast. Presented at the 37th annual meeting of the Society of Historical and Underwater Archaeology, January 8-10, 2004, St. Louis, MO.

2003 A Re-examination of Creolization Theory in Historical Archaeology. Presented at the 5th World Archaeological Congress, June 21-26, 2003, Washington, D.C.

2003 Archaeology, Meaning, and Symbolism of Prehistoric South Florida and the Caribbean Taíno. Presented at The Milwaukee Institute of Art and Design, April 10, 2003, Milwaukee, WI.

2003 Trinkets and Baubles: Creolization and the Relevance of Glass Beads on an Historic Slave Site, Stafford Plantation, Cumberland Island National Seashore. Presented at the 68th annual meeting of the Society for American Archaeology, April 9 - 13, 2003, Milwaukee, WI.

2002 New Surfs, New Turfs: a Preliminary Model of 18th Century French Colonial Foodway and Trade Systems. Presented at the 35th annual meeting of the Society of Historical and Underwater Archaeology, January 8-12, 2002, Mobile, AL.

2000 (with R.S. Kidd) From Goat Eaters to Beefeaters: Patterns of Choice and Consumption from the Carolina Point Plantation Slave Village, USVI. Presented at the 57th annual meeting of the Southeastern Archaeology Conference, November 8-11, 2000, Macon, GA.

Publications and Reports

Hardy, Meredith
In review *Salt River Bay National Historical Park and Ecological Preserve – Archaeological Overview and Assessment*. National Park Service, Southeast Archaeological Center, Tallahassee, FL. Scheduled for 2008.

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In review *Christiansted National Historic Site – Archaeological Overview and Assessment*. National Park Service, Southeast Archaeological Center, Tallahassee, FL. Scheduled for 2008.

Hardy, Meredith, with contributions by Guy Prentice, Maria Fashing, and Gabrielle Shahramfar
In review *Archaeological Survey of Sampson Island, Congaree National Park*. National Park Service, Southeast Archaeological Center, Tallahassee, FL.

Hardy, Meredith
2007 *Archaeological Investigations at Salt River Bay National Historical Park and Ecological Preserve, St. Croix, United States Virgin Islands*. National Park Service, Southeast Archaeological Center, Tallahassee, FL.

Hardy, Meredith, and Guy Prentice
2007 *Congaree Swamp National Monument – Archaeological Overview and Assessment*. National Park Service, Southeast Archaeological Center, Tallahassee, FL.

Yerkes, Richard, W., William Parkinson, Apostolos Sarris, Attila Gyucha, Meredith Hardy, and Luigi Catanoso
2007 Geophysical and Geochemical Investigations at Two Early Copper Age Settlements in the Körös River Valley, Southeastern Hungary. *Geoarchaeology* 22(8):845-871.

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2006 *Archaeological Investigations at Buck Island Reef National Monument, St. Croix, U.S. Virgin Islands*. SEAC Accession Number 1853. National Park Service, Southeast Archaeological Center, Tallahassee, FL.

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2006 *Buck Island Reef National Monument – Archaeological Overview and Assessment*. National Park Service, Southeast Archaeological Center, Tallahassee, FL.

Parkinson, William A., Attila Gyucha, Richard W. Yerkes, Meredith Hardy, and Margaret Morris
2005 Settlement Reorganization at the End of the Neolithic in Central Europe: Recent Research in the Körös River Valley, Southeastern Hungary. *Journal of Eurasian Prehistory* 2(2):57-73.

Hardy, Meredith
2004 Soil chemistry at the Körösladány-Bikeri (K-14) Site, Békés County, Hungary. Manuscript on file, Department of Anthropology, Florida State University, Tallahassee, FL.

Hardy, Meredith, with contributions by John E. Cornelison, Tammy D. Cooper, and Jeff Jones
2004 *Archaeological Monitoring and Testing for the Reconstruction of Building IV, 419 Decatur Street, Vieux Carré, New Orleans, Louisiana.* Jean Lafitte National Historical Park and Preserve. National Park Service, Southeast Archaeological Center, Tallahassee, FL.

Hardy, Meredith
2000 Ceramics from the San Marcos Shipwreck. In *An Archaeological Investigation of the San Marcos Shipwreck (8WA501) and a Submerged Cultural Resources Survey of the St. Mark's River, 29 June to 07 August 1998*, edited by Chuck Meide. Underwater Archaeology Research Reports No. 2, Program in Underwater Archaeology, Florida State University, Tallahassee, FL.

Books, Chapters, and Articles in Progress

- With Kenneth Kelly, University of South Carolina. *French Colonial Archaeology in the Southeast*. University Press Florida. Publication target date: 2008. An edited volume of papers focusing on the archaeology of French colonial lands throughout the southeastern United States, Caribbean, and South America.
- Chapter: Section 110 Survey at Buck Island Reef National Monument and Salt River Bay National Historical Park and Ecological Preserve. In *Pursuit of the Past through Compliance Archaeology in the Caribbean Islands*. University of Alabama Press. An edited volume on cultural resource management in the Caribbean.
- Chapter: The Vescelius Collection, St. Croix Archaeological Survey. Yale University Publications in Anthropology. In Review.

Specialized training and research

- Archaeological Resources Protection Act. U.S. Department of Homeland Security, Federal Law Enforcement Training Center. November 2004, and April 2006.
- Taking soil samples with Geoprobe ® 540 RT/D direct push coring system, with hand corer, with Russian peat auger, and point samples from exposed soil profiles.
- Environmental archaeological laboratory procedures for the following (Department of Archaeology and Saami Studies, University of Umeå, Umeå, Sweden. September-December 2001): methods for taking soil samples, chemical testing for particle size, total and extractable phosphate analysis, magnetic susceptibility, loss on ignition, preparation of pollen samples and slides, pollen analysis, macrobotanical analysis.
- Analysis of thin sections from prehistoric ceramics.
- Analysis of prehistoric Caribbean ceramics.
- 17th through 20th century French, Spanish, English, American, and Scandinavian ceramics.
- Glass analysis workshop conducted by Olive Jones, Parks Canada, Quebec, Canada. January 2000.
- Primary research in parish notarial archives (Orleans, Baton Rouge, Lafourche parishes, Louisiana).
- Primary archival research at Office of Deeds (Christiansted, St. Croix, U.S. Virgin Islands; Charlotte Amelia, St. Thomas, U.S. Virgin Islands).

- Primary archival research at research libraries and institutions (Whim Plantation Research Library and Archives, Frederiksted, U.S. Virgin Islands; Williams Research Center, New Orleans, LA).
- Primary archival research at the Public Records Office (National Archives, London, England).
- Red Cross first aid and CPR